HOUSATONIC RIVER FLOOD CONTROL

DANBURY, CONN.

LOCAL PROTECTION

STILL RIVER, CONNECTICUT

DESIGN MEMORANDUM NO. 2

GENERAL DESIGN AND SITE GEOLOGY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

JANUARY 1969

15

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

IN REPLY REFER TO:

NEDED-E

21 January 1969

SUBJECT: Danbury Local Protection Project, Still River, Housatonic River Basin, Connecticut, Design Memorandum No. 2, General Design and Site Geology

Chief of Engineers
ATTN: ENGCW-E

There is submitted herewith, for review and approval, Design Memorandum No. 2, "General Design and Site Geology," for the Danbury, Connecticut, Local Protection Project, Still River, Housatonic River Basin, in accordance with EM 1110-2-1150. Data requested in OCE 1st Indorsement, dated 23 October 1968, of Design Memorandum No. 1, "Hydrology and Hydraulics," is also included.

FOR THE DIVISION ENGINEER:

John Wm Leslie

1 Incl (10 cys)
as

JOHN Wm. LESLIE
Chief, Engineering Division

FLOOD CONTROL PROJECT

DANBURY LOCAL PROTECTION PROJECT
STILL RIVER
HOUSATONIC RIVER BASIN
CONNECTICUT

DESIGN MEMORANDUM NO. 2

GENERAL DESIGN AND SITE GEOLOGY

INDEX TO DESIGN MEMORANDA

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1	Hydrology and Hydraulic Analysis	29 Aug 1968	23 Oct 1968
2	General Design and Site Geology		
3	Concrete Materials		
4	Embankments, Foundations and Channel Improvements		
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DANBURY LOCAL PROTECTION PROJECT

Still River
Housatonic River Basin
Connecticut

DESIGN MEMORANDUM NO. 2

GENERAL DESIGN

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DANBURY LOCAL PROTECTION PROJECT
STILL RIVER
HOUSATONIC RIVER BASIN
CONNECTICUT

A. PERTINENT DATA

1. PURPOSE	Flood Control
2. LOCATION	
State	Connecticut
County	Fairfield
City	Danbury
River	Still
Distance from New Haven	34 Miles
Distance from Stamford	29 Miles
Distance from Hartford	58 Miles
Distance from New York, N.Y.	66 Miles
3. DRAINAGE AREAS	
Still River at Triangle Street Danbury	31.0 Sq. Mi.
Sympaug Brook at Still River	7.3 Sq. Mi.
Still River at Cross Street Danbury	38.3 Sq. Mi.
Still River near Lanesville Connecticut	68.5 Miles

4. RECORD OF FLOODS

Calendar Year	Date	Peak Discharge, cfs Measured at Lanesville	Peak Discharge, cfs Computed at Danbury*
1955	16 October	7,980	5,000
1955	19 August	3,920	2,770
1938	22 September	3,590	
1936	12 March	3,260	

* Values obtained at Cross Street bridge from computations by the USGS

5. CRITERIA FOR DESIGN OF TOP OF STRUCTURES

Rectangular Reinforced Concrete Section	Pass Standard Project Flood with 2.3 feet of Freeboard
Riprapped Trapezoidal Channel	Pass Standard Project Flood with Minimum Freeboard of 3.0 feet

6. RECTANGULAR REINFORCED CONCRETE SECTION

Length	3,625 feet
Width	40 feet
Depth	13 feet
Invert Slope	0.002 ft./ft.

7. RIPRAPPED TRAPEZOIDAL CHANNEL

Length	2,695 feet
Width	75 feet
Invert Slope	0.0010 ft./ft.
Side Slopes	1 Vertical to 2.5 Horizontal

6320

8. RAILROAD BRIDGES

Number	4
Location	No. 1 Station 10+58 No. 2 Station 24+72 No. 3 Station 38+31 No. 4 Station 70+64
Type	No. 1 Reinforced Concrete Box Culvert. No. 2 Reinforced Concrete Box Culvert. No. 3 Reinforced Concrete Box Culvert. No. 4 Two Span Through-Plate Girder Bridge.

9. HIGHWAY BRIDGES

Number	2
Location	No. 1 Station 37+56 No. 2 Station 52+82
Type	No. 1 Reinforced Concrete Box Culvert. No. 2 Two Span Highway Bridge.

10. RELOCATIONS

Railroad	Track and Signal Lines
Utilities	
a. Storm Drains	As Required
b. Water	6, 8 and 12 inch Lines
c. Gas	9 and 10 inch High Pressure Lines
d. Sewer	As Required
e. Telephone Manhole Lines	 One Overhead
f. Electric	Overhead

11. REAL ESTATE

Type of Acquisition	
Fee	None
Easements	
Permanent	16 acres
Temporary	6 acres
Improvements	2 Homes with Garages 1 Industrial Garage 1 Barn 1 Shed

12. PRINCIPAL QUANTITIES

Excavation General	210,000 c.y.
Stone Protection	11,500 c.y.
Gravel, Fill	32,000 c.y.
Sand, Fill	7,000 c.y.
Earth, Fill	83,000 c.y.
Concrete	24,600 c.y.
Cement	36,900 bbls.
Reinforcing Steel	2,460,000 lbs.
Sheeting (Permanent)	1,300 s.f.
Sheeting (Temporary)	103,500 s.f.

13. ESTIMATED PROJECT COST (1969 Price Levels)

Project Features	Cost
Lands and Damages	$300,000
Relocations	1,250,000

13. ESTIMATED PROJECT COST (1969 Price Levels) (Cont'd)

Project Features	Cost
Channels and Canals	$4,258,000
Engineering and Design	340,000
Supervision and Administration	282,000
Estimated Total Project Cost	$6,430,000

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

FLOOD CONTROL PROJECT

DANBURY LOCAL PROTECTION PROJECT
Still River
Housatonic River Basin
Connecticut

DESIGN MEMORANDUM NO. 2

GENERAL DESIGN

B. INTRODUCTION

1. PURPOSE. - The purpose of this memorandum is to present the general plan, the site geology and the concrete materials for the Danbury Local Protection Project. It will serve as a basis for further planning and design studies.

2. SCOPE. - This memorandum covers the entire project. It presents general data on the functions, costs, and benefits, a general description of the project and specific data on site geology and concrete materials for the project.

C. AUTHORIZATION

3. AUTHORIZATION. - The Danbury Local Protection Project was authorized as a part of the Housatonic River Basin flood protection plan by the Flood Control Act of 1965, Public Law 89-298, dated October 27, 1965, which reads in part as follows:

"The protection for flood protection on the Housatonic, Naugatuck, and Still Rivers, at Derby and Danbury, Connecticut, are hereby authorized substantially as recommended by the Chief of Engineers in House Document Numbered 324, Eighty-eighth Congress, at an estimated cost of $5,100,000."

Local interests, prior to construction, are required to give assurances satisfactory to the Secretary of the Army that they will:

"a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the project including lands for spoil disposal, storm water pondage, and collector ditches together with necessary changes to sewage systems, highway bridges and roads, railroad track except railroad bridges and approaches, and other utilities;

"b. Hold and save the United States free from damages due to the construction works;

"c. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army; and

"d. Prevent encroachment on improved channels and on ponding areas and if capacity of the latter is impaired, provide equally effective storage, pumping capacity, or both, without cost to the United States."

The present estimated cost of the project is $6,430,000. The present Federal share is $5,270,000 and the non-Federal share is $1,160,000.

D. INVESTIGATIONS

4. PREVIOUS INVESTIGATIONS. - Flood control in the Housatonic River Basin has been considered in the following reports:

a. "308" Report. - A report, dated June 25, 1931, and printed as House Document No. 246, 72nd Congress, 1st Session, considered the needs for navigation, water power, flood control, and irrigation in the Housatonic River Basin. The report found that further improvements were not warranted at that time.

b. 1940 Report. - A report, dated June 20, 1940, and printed as House Document No. 338, 77th Congress, 1st Session, recommended construction of the Thomaston Dam on the Naugatuck River (authorized by the 1944 Flood Control Act). The report found that flood losses along the main stem of the Housatonic were insufficient to warrant reservoir protection. The report also found local protective works were not warranted at that time at any location in the Housatonic River Basin.

c. NENYIAC Report. - Flood control and allied water uses were also considered in Part 2, Chapter XXII, "Housatonic River Basin," of The Resources of the New England - New York Region. This comprehensive report inventoried the resources of the New England - New York area and recommended a master plan to be used as a guide for the regional planning, development, conservation, and use of land, water and related resources of the region. Also included were proposals to reduce flood losses. Prepared by the New England - New York Inter-Agency Committee, the report was submitted to the President of the United States by the Secretary of the Army on April 27, 1956. Part I and Chapter I of Part 2 are printed as Senate Document No. 14, 85th Congress, 1st Session.

d. Interim Reports Submitted Under the September 1955 Resolution.

(1) Upper Naugatuck River above Torrington. - An interim report printed as House Document No. 81, 85th Congress, 1st Session, reviewed the need for additional flood control works on the upper Naugatuck River upstream from the authorized Thomaston Reservoir. The report recommended two additional flood control dams and reservoirs upstream from Torrington, Connecticut, one on Hall Meadow Brook and one on the East Branch of the Naugatuck River. These projects were authorized by the Flood Control Act of 1958, and are in operation.

(2) Naugatuck River. - An interim report printed as House Document No. 372, 86th Congress, 2nd Session, reviewed the need for additional flood control works in the mid-reaches of the Naugatuck River Basin. The report recommended four reservoirs on tributaries of the Naugatuck River below the Thomaston Dam: Northfield Brook, Black Rock (on Branch Brook), Hancock Brook, and Hop Brook Dams. These projects were authorized by the Flood Control Act of 1960. Northfield Brook and Hancock Brook Dams are complete. Black Rock and Hop Brook Dams are under construction.

(3) Ansonia-Derby Local Protection. - A third interim report, printed as House Document No. 437, 87th Congress, 2nd Session, reviewed the need for additional flood control works on the lower Naugatuck River. The report recommended a local protection project for Ansonia and a small contiguous area in Derby, Connecticut, consisting of dike, floodwalls, and related works. This project was authorized by the Flood Control Act of 1962. It is currently under construction.

(4) A fourth and final interim report, under the authorizing resolution, printed as House Document No. 324, 88th Congress, 2nd Session, reviewed the need for additional flood control in the

remainder of the Housatonic River Basin. This report recommended local protection works at the cities of Danbury and Derby, Connecticut, consisting of channel improvements, dikes, floodwalls and related works. These projects were authorized by the Flood Control Act of 1965.

e. Projects Not Specifically Authorized by Congress. - Under authority of Section 205 of the 1948 Flood Control Act, as amended, local flood protection projects have been constructed on the East Branch and Naugatuck River at Torrington, on the West Branch, Naugatuck River at Torrington, and on the Naugatuck River at Waterbury-Watertown.

5. CURRENT INVESTIGATIONS. - In order to determine the most practical design for the project, basic data obtained in the previous studies were fully utilized. Additional studies for the project plan were made as follows:

a. New surveys and additional subsurface investigations.

b. Hydrologic and hydraulic studies to determine the detailed design requirements of the structures.

c. Appraisal of lands and damages within the area for project requirements.

d. Hydrology Design Memorandum has been submitted.

6. COORDINATION WITH OTHER AGENCIES.

a. The following Federal Agencies were asked to furnish their views:

(1) U. S. Department of the Interior
Fish and Wildlife Service

(2) U. S. Department of Health, Education and Welfare

(3) U. S. Bureau of Public Roads

b. The following Connecticut State Agencies were asked to furnish their views:

(1) Board of Fisheries and Game

(2) Water Resources Commission

(3) Department of Agriculture, Conservation and Natural Resources

The respective letters of comment are contained in Appendix B.

7. PUBLIC HEARINGS. - Public hearings were held on 2 and 3 May 1961, in New Milford, Connecticut, and Great Barrington, Massachusetts, respectively, to ascertain the views of those interested in flood control and allied measures on the Housatonic River and its tributaries (except the Naugatuck, for which a hearing was held in connection with previous reports). At the New Milford hearing, several persons proposed a plan for protection of the area. The Director of Health, New Milford, reported a health menace from contaminated water flooding wells. Other individuals requested flood protection in the form of flood control, channel improvement, and the removal of a dam in Kent.

At the Great Barrington hearing, individuals urged that the Housatonic River channel be straightened and improved, as well as the removal of bridges and creation of additional flood control storage. One speaker asked for a flood prevention project for Derby, Connecticut.

E. LOCAL COOPERATION

8. LOCAL COOPERATION. - Local cooperation, as stated in Paragraph 3 above, is required. Formal request for assurances will be made after approval of the General Design Memorandum.

F. LOCATION OF THE PROJECT

9. LOCATION OF THE PROJECT. - The project is located on the Still River in the City of Danbury, Fairfield County, Connecticut. It is 29 miles, 34 miles and 58 miles distant from the cities of Stamford, New Haven and Hartford, Connecticut, respectively, and 66 miles from New York City, New York.

10. DESCRIPTION OF THE AREA. - The Housatonic River Basin is located in the western part of Connecticut and the southwestern corner of Massachusetts with a small portion extending into New York. It lies within the confines of Fairfield, Hartford, Litchfield and New Haven Counties in Connecticut, Berkshire County in Massachusetts, and Dutchess and Columbia Counties in New York.

The main valley is broad and steep walled in the upper and middle portions, but narrower near New Milford, Connecticut. The northern perimeter of the basin is ringed with steep sided mountains, rising 1,500 feet above the valley to elevations of about 2,600 feet above mean sea level. In the mid reaches of the basin, the hilltops rise approximately from 700 to 1,000 feet above the valley bottom. The tops of the hills in the lower part of the basin tower about 500 feet above the valley floor.

The climate of the basin differs markedly between the southern and northern sections. The southern section has fairly mild winters and hot summers, whereas the northern section has shorter, cooler summers and much colder winters. The average annual temperature in the Housatonic River basin is 47° F, the extremes of recorded temperature range from 105° F to minus 25° F. Lying in the path of the "prevailing westerlies," which often include cyclonic disturbances that approach from the west and southwest, the basin is subject to frequent but short periods of heavy precipitation. It is also exposed to occasional coastal storms that travel up the Atlantic Seaboard, some being of tropical origin and hurricane intensity.

The basin encompasses all or parts of 40 towns and 7 cities in Connecticut, 22 towns and one city in Massachusetts, and 11 towns in New York. The population of the basin, based on the 1960 U. S. Census, is estimated to be 503,000, of which 385,000 are in Connecticut, 95,000 in Massachusetts, and 23,000 in New York.

The Housatonic River and its watershed are shown on U. S. Geological Survey quadrangle sheets at a scale of 1:31, 680 and 1:62, 500 and also on U. S. Army Map Service maps at a scale of 1:25, 000.

Danbury has an area of 42.7 square miles and is governed by a Mayor and Council. It was first settled in 1685, was incorporated as a town in 1687, and as a city in 1889. Although Danbury was founded as an agricultural community, manufacturers now produce a large number of diversified products. Among these products are hats and hat bodies, ball bearings, electrical goods, apparel, rubber tile, stamped metal goods, machinery for the hatting industry, surgical instruments, surgical sutures, and electronic control devices.

G. RECOMMENDED PROJECT PLAN

11. RECOMMENDED PROJECT PLAN. - The recommended project plan consists of channel improvement, realignment, excavation and backfilling.

The project will start 50 feet upstream of the present end of the completed Still River Channel, Urban Renewal Project, and extends downstream a distance of approximately 6,350 feet, ending 600 feet downstream of Triangle Street bridge where it connects to the completed Connecticut State Still River Channel Improvement Project. It will require the demolition and construction of four (4) railroad crossings; the demolition of one privately-owned highway bridge; the construction of two highway crossings; and the filling of the old river channel.

Necessary drainage structures, as required, will be constructed.

The project features are discussed in detail in Paragraphs 25, and 39 through 41.

H. DEPARTURES FROM THE AUTHORIZED PLAN

12. DEPARTURES FROM THE AUTHORIZED PLAN. - The development of detailed design studies including consideration of additional information resulted in modifications and changes from the plan on which authorization was based. These changes are set forth below:

a. A reinforced concrete "U" shaped section was substituted for the channel excavation and retaining walls for the first 3,615 feet of the project.

b. The "U" shaped channel width was made constant (40 feet) replacing the varying channel widths required in this section of the project.

c. The remaining channel bottom was paved throughout replacing the rock toes at the base of the slope protection.

d. The pilot channel was eliminated and replaced by "V" shaped invert with a uniform depth from edges of channel to the center.

I. HYDROLOGY AND HYDRAULICS

13. HYDROLOGY - PROJECT DESIGN FLOOD. - The protective works on the Still River will be designed to contain the maximum river stages resulting from the standard project flood developed in accordance with procedures described in Civil Works Engineer Bulletin 52-8. The

standard project flood hydrograph was developed by applying the standard project storm excess rainfall to an adopted unit hydrograph for the Still River at Cross Street in Danbury. The 3-hour unit hydrograph was developed from analysis of the record floods of August and October 1955 using discharge records obtained at the USGS streamflow gage on the Still River at Lanesville, Connecticut. The peak SPF discharge resulting from this analysis for the project reach is 6,900 cfs.

14. HYDRAULIC ANALYSIS - GENERAL. - Hydraulic analyses were conducted to determine the channel geometry, the resulting water surface profiles and associated velocities. Computation of flow profiles were aided by the use of computer program 22-J2-L212, furnished by the Sacramento Hydrologic Engineering Center.

15. CONCRETE RECTANGULAR CHANNEL. -

a. Channel geometry and flow characteristics. - The upstream portion of the project will consist of approximately 3,500 feet of rectangular open channel constructed of structural concrete walls and invert. The channel will have a base width and wall depth of 40 and 13 feet, respectively, and an invert slope of 0.002 feet per foot. Using a Manning's "n" value for design of 0.015 (HDC 631 and 631-1, revision 1-68) and the SPF peak flow of 6,900 cfs, the adopted geometry resulted in a flow depth of 10.7 feet or 10 percent greater than critical depth. The adopted wall height of 13 feet will provide slightly more than 2 feet of freeboard.

b. Inlet and outlet transitions. - The upstream end of the concrete rectangular channel is connected to an existing 72 foot wide rectangular channel by a 100 foot long transition. In the transition the channel invert will drop 6.53 feet while converging to a 40-foot width. The incoming design flow will accelerate from 8.9 to 25.1 fps at the bottom of the transition and then, approximately 600 feet downstream, will jump hydraulically to the normal flow depth and velocity of 16.2 fps.

At the downstream end of the concrete channel flows will drop 2.8 feet into a 55-foot wide stilling basin where excess energy will be dissipated before entering the riprapped trapezoidal channel.

16. RIPRAPPED TRAPEZOIDAL CHANNEL. -

a. Channel geometry and flow characteristics. - The Still River flows will be conveyed in a riprapped trapezoidal channel from the outlet of the concrete rectangular channel to the end of the project. The channel will have side slopes of 1 on 2.5 and the bottom width will

diverge in the first 435 feet from a width of 55 to 75 feet. In the initial 665 feet, the channel invert will transition from level to a triangular "V"-shape with the center 3 feet lower than the outside edges. This will provide confinement of normal low flows. The channel invert slope will vary from 0.00117 between Stations 45+35 and 52+00, to 0.0010 between Stations 52+00 and 70+00, and 0.0038 between Stations 70+00 and 72+00.

Using a Manning's "n" of 0.035 and loss coefficients of 0.3 and 0.2 for expansion and contraction, respectively, the maximum velocities for design discharge vary from 5.9 to 6.8 fps. The design depth of the channel and heights of dikes were established to provide a minimum of 3 feet of freeboard above the design water surface profile.

Additional specifics on Hydrology and Hydraulics are presented in approved Design Memorandum No. 1, Hydrology and Hydraulic Analysis.

J. SITE GEOLOGY, FOUNDATIONS, EMBANKMENTS AND MATERIALS

17. DESCRIPTION OF PROJECT. - The Danbury Local Protection Project is located on the Still River in the City of Danbury, Connecticut, approximately 300 feet downstream of the White Street Bridge.

The proposed structures are shown on Plate 1, General Plan and Plan of Foundation Explorations. The project consists of channel improvement and realignment utilizing concrete lined and open channel sections beginning at the end of the Central Flood Urban Renewal Project and continuing approximately 6,320 feet downstream. Present plans anticipate the use of a rectangular reinforced concrete section for the first 3,625 feet and an open trapezoidal shaped channel with stone protection for the remainder of the project.

18. TOPOGRAPHY. - The project is located in the Western Connecticut highlands, an area of plateau remnants sloping gently to the southeast. The topography is of moderate relief consisting of steep sided rock controlled valleys mantled by thin glacial deposits of ground moraine. Temporary lakes formed by local damming of the valley by remnant ice blocks during glacial recession caused the deposition of thick beds of fine silts and clays with intermediate terraces of coarser grained deposits.

The Still River occupies a broad, relatively flat valley and flows northward to join the Housatonic River, a major drainage basin of the western highlands. The meandering course of the river is controlled by bedrock sills which have exercised considerable control on the stream

gradient and rate of downcutting. Bedrock of the area primarily consists of hard Paleizoic schists and gneisses on the highland with the Still River valley occupying a zone of soft, more easily erodible marbles.

19. SURFICIAL AND SUBSURFACE INVESTIGATIONS. -

a. Previous Investigations. - Field reconnaissances and data from borings made for the Urban Renewal Project local bridge structures provided geology and soils information for the 1963 Housatonic River Basin Survey Report.

b. Current Investigations. - Investigations initiated in May 1968 consist of detailed field reconnaissances and to date 28 borings along the proposed structures (see Plates No.8 and No.9). Additional foundation explorations are in progress to provide greater detail for foundation analyses. Present plans anticipate an additional 29 borings on the proposed structures. All test borings are continuously drive-sampled in overburden and core-drilled in rock where encountered to a minimum depth of 15 feet.

20. SURFICIAL GEOLOGY. - The Still River at the project flows from the west toward the southeast over a gently sloping alluvial filled valley. The stream closely follows the northern edge of the highlands from which project bedrock controlled spurs that have influenced the course of the stream drainage during the erosion cycle. Intermediate to these spurs, the valley floor presents a generally flat surface which has been surficially modified by recent deposition of fill and by land development coupled with flooding and stream control modifications. There are no bedrock exposures within the project area. Weathered exposures of marble occur to the southwest, and granitic gneiss to the east of the project area. Deposition of stratified drift in the valley has changed the course of the preglacial Still River channel and forced the stream to cross a resistant rock rib to the east thus preventing further downcutting of the stream in the upper reaches of the river channel. Reversal of the drainage flow to the north has resulted in a natural development of a subsequent drainage profile resulting in a heterogeneous deposition of lake sediments and coarser glacial outwash deposits of stratified drift. This development of stream drainage within preglacial valley walls has resulted in localized thick peat and fine grained lake deposits overlain by glacial drift and buried former river courses. The subsequent stream control has been largely influenced by the differential weathering characteristics of the marble and granitic formations. Above the valley floor glacial deposition has formed local moraines which have blocked preglacial drainage divides and caused the development of kames, eskers, and terraces of stratified drift which primarily occur

as skirts along the valley walls to approximately the 400 foot contour. Above these glacial fluvial deposits the relief is largely bedrock controlled with a thin bouldery veneer of ground moraine with localized thicker deposits of till shaped as drumloidal features at the higher elevations.

21. FOUNDATION CONDITIONS. -

a. Overburden. -

(1) Upstream of Station 47+00, a generalized stratigraphic sequence of subsurface conditions within the limits of the project structures is shown on Plate No.7. The unconsolidated stratified drift deposits of silty sands and gravels are relatively thin and overlie deposits of moderately compact, variably stratified silts, clays and highly silty fine sands. The surface configurations of the bedrock has influenced the depositional sequence resulting in erosion of the softer fine-grained deposits in the vicinity of Stations 25+00 and 45+00. In the areas of shallow bedrock at approximately Stations 30+00 and 45+00 increased stream velocity has resulted in the deposition of boulders and coarse gravels.

The alignment of the proposed channel follows closely the course of the river, and the channel invert elevation is about six feet below river bed elevation. The proposed channel is wider than the river channel, and construction will require excavation of either one or both riverbanks which are generally 5 to 10 feet high. The bottom of excavations will be 15 to 20 feet below top of bank and about 10 feet below riverbed. The groundwater elevation is close to river gradient elevation except where affected by fill or drainage structures.

The deposits above riverbed elevation is manmade consisting mainly of loose cinders, ashes, sands, gravelly sands and dumped riprap at random locations. The deposits in half of the reaches of required excavation along the riverbanks consist entirely of cinders and ashes. The deposits of sands and gravelly sands contain varying amounts of cinders and ashes. The trash is generally a minor proportion and consists of bricks, glass, and mill waste. A one to four foot thick layer of soft silt which is frequently organic underlies most of the manmade deposit.

At and below the elevation of the riverbed, there is a deposit which consists generally of loose to moderately compact sands, gravelly sands, and sandy gravels, all containing a relatively small percentage of silt. The deposit is about 5 feet thick at the upstream end of the proposed channel and about 25 feet thick at the downstream end; in the intermediate reaches the thickness varies irregularly. The deposit

overlies loose to moderately compact silt, sandy silt and clayey silt, except in the vicinity of Stations 30+00 and 45+00 where it overlies rock.

Foundation investigations made to date indicate that the required excavations along about a third of the concrete channel alignment will extend 1 to 5 feet into the silts. A relatively short area in the vicinity of Station 30+00 will require some rock excavation.

(2) Downstream of Station 47+00. The proposed channel cuts off from the present course of the river starting at about Station 47+00 and rejoins it at about Station 66+00. Between Stations 47+00 and 50+00, channel construction will require a maximum 40 foot deep excavation through a moderately high hill. Between Stations 50+00 and 60+00, the area is a relatively flat terrace and the proposed channel invert will be generally 15 to 30 feet below existing ground surface. Beyond Station 66+00, the proposed channel follows the course of the river and the proposed invert is generally less than 5 feet below riverbed; riverbanks are generally 5 to 10 feet high.

The soils within required excavation in the area of the hill consists generally of loose to moderately compact gravelly sand, sandy gravel, and sand, all containing a relatively small percentage of silt. The lower portion of the excavation in the vicinity of Station 48+00 will be partially in rock. Downstream of Station 50+00, the soils within required channel excavation consist generally of gravelly sand, sandy gravel and sand, and at random locations contains stratified zones of less pervious silty sands, man-made fill, and thin layers of silt with organics. The consistency of subsurface water levels in the borings approaching the natural gradient of the stream is indicative of the uniformity and to some degree the lateral extent of these generally granular deposits. This is particularly evident in the gradient levels between Stations 47+00 and 60+00 where the project plan diverts from the natural streams.

Investigations to date indicate that sandy silt, silt and clayey silt may be encountered near the bottom of required excavations downstream of Station 67+00.

b. Bedrock. - The bedrock encountered in the borings is a massive, white, hard marble formation containing small intrusive granitic bodies. Limited areas in which the bedrock encroaches on the project structures are at Station 30+00 and between Stations 46+00 and 50+00. The marble composition is highly variable and may be comprised of entirely calcite or dolomite or a mixture of these

materials. Where highly calcitic, the marble is generally weathered and decomposed for the first 3 to 5 feet, particularly in areas where it is at or above the level of ground water. The rock where fresh is generally not jointed and contains few foreign inclusions resulting in a relatively homogeneous rock texture.

The rock is amenable to shaping by line drilling or presplitting methods of excavation but where highly calcitic would tend to weather rapidly on exposure to a sandy material with a slope of approximately 45°. Slope design should consider the weathering characteristics of the rock. The rock is not suitable for use as stone protection. Where the rock is not subjected to alternate wetting and drying, it is considered to be of excellent bearing in the order of 20,000 psi with dry unit weight of approximately 173 pcf. Where intruded by granitic bodies, some mechanical deformation with associated high angle shear zones is expected and may govern to a limited degree the shaping of design slopes.

22. CONSTRUCTION CONDITIONS, FOUNDATIONS, EMBANKMENTS AND FOUNDATION TREATMENT. -

a. Rectangular Reinforced Concrete. - A drainage blanket will be placed longitudinally below the bottom of the slab of the concrete U-frame structure and along its vertical walls to prevent development of large hydrostatic pressures, and also to control seepage during the construction. Where the bottom of the excavation is silt, a layer of gravel will be placed upon the silt to provide a working base for construction and also to provide filter action with the overlying drainage blanket. Seepage will be collected by longitudinal pipes which discharge to the channel.

It is anticipated that construction sheeting or a sand-packed well point system (vacuum method) will be needed in silt foundation areas below the elevation of the ground water table. Construction sheeting will be needed for shoring the sides of excavations which are close to buildings and railroad tracks. Excavation seepage control in pervious foundations may be done either by open pumping and pervious blankets placed on side slopes or by well points. The widths of excavations will be made ample enough to permit construction of drainage ditches and operation of compaction equipment.

b. Trapezoidal Shaped Channel. - Channel excavation will be generally less than 15 feet deep. In the channel reach between Station 47+00 and 50+00, the top of the cut slope will be as high as 55 feet above the toe of the slope, and for a short reach in the vicinity of Station 54+00, it will be about 35 feet. The channel bottom and side slope up to an elevation of three feet above the

elevation of the standard project flood will be protected with stone slope protection overlying a gravel bedding, and above that elevation the slopes will be covered with crushed stone.

c. Embankments. - There are low relief areas along the alignment of the trapezoidal shaped channel where small earth embankments are required. The top of embankments will be generally less than 7 feet high above landside ground and less than 15 feet above channel side toe of slope. The embankments will be homogeneous compacted earth fill. Foundation treatment will consist of removal of topsoil, highly organic soils, and manmade fills that contain open-work trash or other undesirable materials.

The channel side slopes will be covered by protection stone on gravel bedding. The top and landside slopes will be grassed.

23. CONSTRUCTION MATERIALS.

a. Earth Fill Materials. - The major portions of materials for earth fills (other than gravel, gravel bedding and drainage blanket materials) will be obtained from the required excavations.

b. Gravel Fill and Gravel Bedding Materials. - Materials for gravel fill and gravel bedding will be furnished by the contractor from off-site sources. Suitable sources of gravel materials exist within 10 miles of the project.

c. Stone Protection. - Bedrock in the project and adjacent area is not generally suitable for use as stone protection. Suitable rock may be obtained from commercially operated trap rock quarries in the Woodbury area approximately 25 haul miles northeast of the project. Other producers of commercial stone are located at slightly greater haul distances from the project.

d. Concrete Aggregate and Subdrain Materials. - An estimated quantity of 14,000 cubic yards of concrete will be required for the project structures. Several commercial sources of natural aggregates are located within 25 miles of the site. A representative number of these sources are presently being investigated and the test data will be published in Design Memorandum No. 3, Concrete Materials.

K. CONCRETE MATERIALS

24. CONCRETE MATERIALS. - In view of the relatively moderate quantity of concrete required, concrete aggregate investigation has been confined

to established commercial sources. Nine commercial sources of processed sand and crushed gravel are located within a fifteen mile radius of the project site. One source of processed crushed stone is rail-hauled to the project area from New Haven Trap Rock Company quarry 50 miles from the site. New Haven Trap Rock Company has been previously tested for civil works construction. B. J. Dolan, Incorporated, Federal Sand and Gravel Company and D'Addario Sand and Gravel Company were selected for evaluation testing as having the best potential for supplying aggregate and are currently being tested. Portland cement is usually supplied to this area from one of the six cement mills in the New York Hudson River Valley or from one of eight mills in the Pennsylvania Lehigh Valley. Concrete materials will be submitted in detail in Design Memorandum No. 3.

L. DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

25. GENERAL. - The project is one of local protection. It is the final link of the Still River Channel Improvement in Danbury, Connecticut. It contains two separate reaches, a 3,625 foot long rectangular reinforced concrete channel and a 2,695 foot long riprapped trapezoidal channel. The project will start 60 feet upstream in the completed Central Flood Urban Renewal Project and end approximately 6,320 feet downstream in the completed State of Connecticut Improved Channel Project. In general, the project extends in an easterly direction. The features of the project are presented in the following paragraphs.

a. Rectangular Reinforced Concrete Section. - Commencing at Station 9+20 and ending at Station 45+45, a rectangular reinforced concrete section will be constructed. It will consist of an intake transition section, a main section, and the outlet transition section.

(1) Intake Transition Section. - An intake transition section 100 feet long will start at Station 9+20 and end at Station 10+20. It will vary uniformly from the existing channel width of 72 feet to the 41.5 foot width of the rectangular reinforced concrete box section. The invert slope will be 0.0026 for the first 50 feet followed by a slope of 0.128 for the remaining 50 feet, dropping 0.13 feet and 6.4, respectively. It will be 13 feet deep.

(2) Main Section. - The main section, exclusive of the sections required for railroad and highway crossings, of the rectangular reinforced concrete section starts at Station 10+20 and ends at Station 44+50. It will be 40 feet wide, 13 feet deep and

have an invert slope of 0.002, with invert elevations of 358.3 and 351.4 feet above mean sea level, respectively. Where the railroad and Chestnut Street cross the rectangular reinforced concrete channel, a reinforced concrete box culvert, with center pier, will be provided.

(3) Outlet Transition Section. - The outlet transition section 85 feet long and 13 feet deep will start at Station 44+60 and end at Station 45+45. It will vary uniformly from the 40 foot width to 55 feet in a distance of 35 feet with a uniform invert elevation drop of 2.8 feet in this distance. The remaining 50 feet will have a level bottom with a two foot high by four foot wide end sill and be 55 feet wide.

For the design of the rectangular reinforced concrete channel section, it is intended to provide drains in back of the walls and above the footing projections. The structural design for the low river level condition will assume that the drains will be effective in reducing the ground water head by an amount equal to 50% of the distance from drain invert to ground surface. The drains will be provided with cleanout points to insure that they are operative. Without this reduction in uplift head, the base projection on either side would become excessive.

Design details of the rectangular reinforced concrete channel section will be presented in Design Memorandum No. 5 Structures.

b. Trapezoidal Riprapped Channel. - The remainder of the project consists of channel improvement, realignment, modification and filling which are described in the following paragraphs.

(1) Channel Improvement. - Starting at Station 45+45 and to Station 47+00, the existing river channel will be improved. The work will consist of widening, deepening and protecting the waterway. The channel will vary uniformly in width from 55 feet to 75 feet in approximately 440 feet and have side slopes of 1 on 2.5. The invert will transition from level to a triangular "V" shape with the center 3 feet lower than the sides in a distance of 655 feet and have a slope of 0.0012. The side slopes will be protected by 12 inches of rock on a gravel bedding of varying thickness to a minimum height of 3 feet above the standard project flood water surface profile. Any slope above this elevation will be protected by 12 inches of crushed stone. Wherever the riverbanks are below the 3 feet above the standard project flood water surface profile elevation, an earth dike will be constructed to the required elevation. The dike will be of rolled earth and have a top width of 20 feet protected by 6 inches of seeded topsoil. The landside slope will be 1 on 2 and be protected with a 6-inch blanket of seeded topsoil. The riverside slope will be a continuation of the channel slope and be protected by 12 inches of rock on gravel bedding of varying thickness.

(2) Channel Realignment. - The channel will be realigned from Station 47+00 to Station 66+20, the upstream face of Triangle Street bridge. It will be a trapezoidal section 75 feet in width and have side slopes of 1 on 2.5. The sides and invert will be protected by 12 inches of rock on gravel bedding. The side slope stone protection will extend to 3 feet above the standard project flood water surface profile. Side slopes within this segment of the project which extend above the rock protection will be protected by 12 inches of crushed stone. Side slopes which are below the stone protection elevation will be built up with the dike section described in the above paragraph. The invert will be a triangular "V" shape with sides 3 feet higher than the center and have a slope of 0.0010.

(3) Channel Modification. - Station 66+20 is the start of the completed Connecticut State Still River Improvement Project. The existing channel in this reach, to Station 72+40 will be modified. This will consist of lowering the invert to the proposed grade and uniformly varying the invert from the "V" shape to level section. The invert will have a 12 inch stone riprapped protection on a 12 inch gravel bedding. Work as required to blend in the design channel side slopes with the existing channel slopes as well as providing stone protection on gravel bedding will be accomplished.

Design details of the stone protection have been presented in approved Design Memorandum No. 1, Hydrology and Hydraulic Analysis.

(4) Channel Filling. - The old riverbed within the project area which lies outside the limits of the proposed work will be filled with acceptable material from the required excavations. It will have a 6-inch seeded topsoil cover, and be graded to drain.

c. Railroad Bridges. - The project will require the demolition and construction of four (4) railroad bridges where the alignment crosses the existing railroad right-of-way. Because the railroad will need to keep operating, it is proposed to enter into a relocations agreement with the owner, The New York, New Haven and Hartford Railroad Company, for this work. The existing structures are described in the following paragraphs.

(1) Railroad Bridge No. 1 is located at Station 10+58 and is identified by the railroad as bridge No. 26.40 on the South Norwalk-Danbury line over the Still River. The present span is approximately 50 feet long and is a two-track ballasted concrete slab bridge of three (3) spans. The track curvature is approximately 16°-20'.

(2) Railroad Bridge No. 2 is located at Station 24+72 and is identified by the railroad as Link Bridge - Danbury Yard No. 26.06.

The present span is approximately 160 feet long, consisting of timber stringers on timber pile bents. It is a single track bridge.

(3) Railroad Bridge No. 3 is located at Station 38+31 and is identified by the railroad as Bridge No. 25.69. It is a single track steel girder bridge approximately 140 feet long consisting of four (4) spans.

(4) Railroad Bridge No. 4 is located at Station 70+64 and is identified by the railroad as Bridge No. 25.14 on the South Norwalk-Danbury line. The present span consists of four (4) DPG spans carrying one track.

The estimates of costs for the above first three structures for this memorandum will be for a reinforced concrete box culvert with center pier and contiguous with the proposed reinforced concrete "U" shaped section. The estimate of cost for the fourth structure will be for a two span through-plate girder bridge with a ballasted steel floor. The south abutment will remain and be modified, and a new center pier and north abutment will be constructed.

d. Highway Bridges. - The project will require the modification of the highway bridge at Chestnut Street and the construction of a new bridge where the proposed alignment crosses Casper Street. It is proposed to enter into a relocations agreement with the owner, the City of Danbury, for the accomplishment of this work.

(1) Chestnut Street Bridge is located at Station 37+56. The existing Chestnut Street Bridge is a two span approximately 87 feet long and 34 feet wide. It has a 22.0 foot travelway and two (2) 6.0 foot wide sidewalks. It is proposed to construct a reinforced concrete box culvert with center pier contiguous with the reinforced concrete "U" shaped channel, and regrade to match existing way.

(2) Casper Street Bridge is located at Station 52+82 where the realigned channel crosses the existing street. Casper Street has a paved bituminous concrete 30 foot travelway with a ten (10) foot concrete sidewalk on its north side. The proposed structure will be a two span highway bridge with center pier, the total length of which will be approximately 150 feet long, with matching travelway and sidewalk.

e. Access. - Access to the project area will be by the regular maintained travelways.

f. Operating Facilities. - No operating facilities are considered necessary at this project since it will be the responsibility of local interests to operate and maintain it.

g. Housing Facilities. - No housing facilities are considered necessary at this installation.

M. VIEWS OF CONSULTANTS

26. CONSULTANTS. - The advice of consultants in the Office, Chief of Engineers, will be obtained as required in the development of the project.

N. ACCESS AND RAILROAD FACILITIES

27. GENERAL. - The following means of access are available in and around the area.

a. Highways. - The various State and Federal highways in and out of the city are as follows:

(1) U.S. #7 north-south from Norwalk, Connecticut, to Pittsfield, Massachusetts and points north.

(2) U.S. #6 east-west from Hartford, Connecticut, and points east to New York Thruway.

(3) U.S. #202 east-west from Holyoke, Massachusetts, to the west.

(4) Conn. Highway #37, Danbury to New Milford.

(5) Conn. Highway #58 - U.S. 202, Danbury to Bridgeport.

(6) Highway #1-84, Brewster to Sandy Hook.

b. Railroads. - The area is served by the Pittsfield Branch and Maybrook Freight Division of the New York, New Haven and Hartford Railroad.

c. Airfields. - There is a local airport with excellent facilities. However, the nearest commercial airport is at Bridgeport, Connecticut, served by the Allegheny Airlines, with eight daily passenger flights.

O. REAL ESTATE REQUIREMENTS

28. REAL ESTATE REQUIREMENTS. - Approximately 16 acres of land will be required for the proposed project of which about 2.6 acres lies in the Still River.

This acquisition will require partial takings from 14 industrial properties including the New York, New Haven and Hartford Railroad. The only improvements which will be required from these industrial properties, excluding railroad tracks, are an old 7 bay, wood frame garage, which is in very poor condition, and also some pavement from four companies' parking lots. It is assumed that any railroad tracks affected by the project will be relocated or raised in place, and, therefore, no damages are included in this report for loss of tracks.

Partial takings of rear land will be required from six older residential properties which front on Sheridan Street. The only improvements required from these properties are an old shed and barn situated on one of the tracts.

Total takings of two residential properties situated on either side of Casper Street will also be required for the project. The homes situated on these lots include a modern one-story, wood framed dwelling with an attached garage and a modern 2-1/2-story wood framed, Colonial type dwelling with a detached 2-car garage.

29. ESTATES TO BE ACQUIRED. - Acquisition of an estimated 22 tracts, as delineated under "Real Estate Requirements," will be required for the proposed project.

If the subject land is purchased in conjunction with the proposed urban renewal project, the land required for channel improvement, extending from the point of beginning to Casper Street, which is in the proposed urban renewal area would most likely be purchased under a fee estate. However, if the land is acquired for strictly channel improvement in the event that the urban renewal project is not approved by the voters of Danbury, it is recommended that permanent easements be acquired in lieu of fee on the 16 acres required for the project. In most cases, easement values will approximate fee values; nevertheless, sound real estate practice indicates that severance damages will be reduced under easement interest as access to remaining land and to the river will be left with the underlying owners.

30. UTILITIES. - City water, sewerage, electricity and telephone facilities are available within the project area.

31. ZONING. - The City of Danbury is presently studying proposed changes in zoning. The land required for the project, presently, falls within four zoning districts. These districts and the minimum requirements include the following:

District	Min. Lot Area	Min. Lot Width
Commercial - CB-10	10,000 sq. ft.	70 ft.
General Industrial - IG-20	20,000 sq. ft.	100 ft.
General Industrial - IG-40	40,000 sq. ft.	125 ft.
Residential - RD-5	5,000 sq. ft.	50 ft.

32. PRESENT AND HIGHEST AND BEST USE. - The highest and best use of the subject land is considered to be its present use, for industrial and residential purposes.

33. SEVERANCE DAMAGES. - Severance damages have been estimated on the basis of "Before" and "After" appraisal methods and reflect an estimate of value losses, which will be incurred by remaining property as a result of partial takings.

For purposes of this report, loss of pavement in privately-owned parking lots is also included under severance damages.

These damages are estimated at $25,000 in addition to the value of the required land.

34. ADMINISTRATIVE COSTS. - If the land required for channel improvement is purchased in conjunction with the proposed urban renewal project, only a portion of the administrative costs required for land acquisition should be assessed against the project. If the land required for channel improvement is purchased separately, administrative costs would be considerably greater.

For purposes of this report, administrative costs, which include mapping, survey, legal descriptions, titles, appraisals, negotiations, closings and administrative costs for condemnation, are estimated at $1,000 per tract, or $22,000 for the required 22 tracts.

35. RESETTLEMENT COSTS. - At the present time, the State of Connecticut has no authority to pay resettlement costs; therefore, costs of moving personal property are not included in this report.

36. CONTINGENCIES. - A contingency allowance of 15% is considered reasonable to provide for possible adjustments or refinements of the acquisition lines, additional ownership which may develop from a detailed search, adverse condemnation awards, and to allow for actual, practical and realistic negotiations.

37. EVALUATION. - A search was made in the City of Danbury to obtain market data for use in estimating the value of the real estate required for the proposed project. Real estate brokers, appraisers, local officials and knowledgeable parties were contacted to secure data and value estimates. A knowledge of the real estate market was obtained from this survey and analysis which forms the basis for estimating the real estate costs of this project as follows:

a. Land (Permanent Easements). -

Good Industrial Land	4.5 acres @ $20,000 P/A	=	$90,000
Fair Industrial Land	5.7 acres @ $12,000 P/A	=	$68,400
Front Residential Land	0.5 acre @ $23,000 P/A	=	$11,500
Rear Residential Land	2.7 acres @ $ 2,400 P/A	=	$ 6,480
Land in water	2.6 acres		0
	16.0 acres		$176,380

b. Improvements. -

2 homes w/garages, 1 old industrial garage, 1 old barn, 1 old shed	$40,000
Total Land and Improvements	$216,380
Rounded to:	$216,000

38. RECAPITULATION. -

Land and Improvements	$216,000
Severance Damages	25,000
Administrative Costs	22,000
Contingencies (15% of $263,000)	39,450
Total Estimated Real Estate Costs	$302,450
Rounded to:	$300,000

P. RELOCATIONS

39. INTERIOR DRAINAGE. -

a. General. - The proposed layout of the local protection project shown on Plates 2-2 through 2-6 is the result of engineering and economic analyses of the Still River in the City of Danbury, Connecticut. The protection will extend from the railroad bridge 400 feet ± east of White Street to a point 600 feet ± downstream of the Triangle Street Bridge. The proposed system of dikes and walls will intercept runoff from approximately 610 acres. Land uses in the interior basin are about 80 percent residential, 15 percent commercial and 5 percent industrial. Developments in the higher elevations of the drainage basin are largely residential. The industrial and commercial developments are located on the flood plain.

b. Topography. - The topography in the City of Danbury is highly irregular, generally consisting of relatively steep slopes intersecting sizable areas of low flat land adjacent to the Still River. The maximum difference in elevation between the northerly perimeter of the drainage area and the river is ± 190 feet. On the southside, the difference in elevation is ± 80 feet.

c. Interior Drainage Basin. - The interior drainage basin consists of all contributing areas from which runoff would be intercepted by the proposed dikes and floodwalls. The total basin has been divided into 9 areas (see Plate No. 2-10). All subdrainage areas shown are contiguous to the protection. Drainage will be collected in these areas and discharged through the dikes or walls by gravity. Table 2-1 gives a breakdown of the storm flows from each area including intensity, infiltration, acreage and time of concentration.

Information on the existing municipal drainage system is very sparse. There are no plans available in the City Engineer's office. The only information on drains consists of that shown on the 1" = 20' topography survey supplemented by field observations and some old railroad drawings. Efforts will be made to coordinate drainage work under this project with any new drainage systems planned or proposed by the City. At present, the City has no layouts of new work.

It is unlikely that the existing drains currently discharging into the Still River have the capacity to handle the flows resulting from storms with an intensity-frequency greater than 10 years. At the present time, flows in the upper reaches of the basin are intercepted by streets running parallel to the river. Runoff not

intercepted by inlets on these relatively flat streets, flows to their intersection with the steeper streets which slope toward the river. These streets conduct the surface flow to the low lying areas contiguous to the protection. In some cases, this drainage flows directly to the river. In other instances, where the protective walls and dikes block this flow, additional inlet capacity will be provided.

d. Design Criteria. - The criteria used in the design of the interceptor storm drains, drains through the protection and subdrains are as follows:

(1) Interceptor Drains. - Interceptor drains along the line of protection will collect runoff that would normally flow overland to the river. They will be designed to carry a 10-year storm runoff with the drain running full and discharging by gravity with a normal river stage.

(2) Storm Drains Discharging into the New Channel. - Storm drains discharging into the new channel will be designed to carry a 100-year storm runoff with the drain running full and with free discharge to the river. The inlet structures for these drains will be designed to receive the interceptor drains as well as overland flow. Each new discharge to the new channel was also analysed to establish its discharge capacity with a project flood stage in the river. This determination was made by ascertaining the difference in elevation between the water surface at the discharge point in the river and the maximum allowable ponding level on the landside of the protection.

(3) Underdrains. - Underdrains will be designed to carry flows based on a maximum rate of 1.0 gpm per linear foot per side of floodwall.

e. Damage Potential in Protected Areas. - The existing industrial developments on the flood plain are presently subject to short duration flooding due to high intensity rainfall and rapid concentration of runoff from the steep slopes accumulating on the flood plain. The damage potential cannot be determined precisely because the complex overland flow pattern and the head discharge relationships of the existing drainage structures may be substantially affected by ice and other debris during critical flood periods. Also the effectiveness of future drainage improvements by the City would improve the situation markedly.

The project will reduce flood stages in the low lying industrial areas during high flows in the Still River. The existing condition of infrequent shallow flooding in the streets and on the industrial flood plain resulting from short duration, high intensity

rainfall will not be completely eliminated unless the city or private interests makes significant improvements in the interior drainage system. Because of the flat topography of the flood plain and its relatively large ponding capacity at relatively shallow depths, the damage incurred from interior drainage flows will be relatively small.

f. Urban Renewal. - At the present time there is an urban renewal project under design that will encompass the new new river channel from the railroad bridge at the start of the project easterly to the existing Casper Street bridge. Proposed drainage work under this project will substantially improve storm drainage in the area. One significant improvement will be the increased discharge capacity with flood stages in the river.

There has been no definite construction schedule established for the urban renewal work. For this reason, work under the protection contract will be designed only for coordination with existing utilities. However, knockout plugs will be provided in conduit walls to facilitate future connections with urban renewal drains.

g. Drainage Systems. - Location, topography and drainage of the 9 interior drainage areas are discussed in the following paragraphs. Proposed drainage systems that will meet the prescribed criteria are presented for these areas. Design discharges for all areas are shown on Table 2-1. References to a length of an area denote the longest flow distance (overland and in pipes) storm drainage has to traverse in getting to the river.

(1) Drainage Area #1. - Area #1 is located northeast of the railroad bridge that crosses the Still River at the upstream end of the project. The southside of this area consists primarily of railroad yards. The northerly section is made up of small business establishments along White Street. The protection in this area will be connected to the existing reinforced concrete channel constructed under a recent City contract. The watershed consisting of 17 acres is approximately 1,400 feet in length with a differential in elevation from 370 to 404 feet m.s.l. The pattern of overland flow is determined by White Street and the railroad tracks in the area. Flows exceeding the limited capacity of the existing storm drains flow through the railroad yards to the proposed river channel. This flow will be intercepted by a 6-inch curb formed by the top of the northerly wall of the new channel extending above finished grade. The flow in this gutter will be relieved at intervals by depressing the wall 6 inches to match the gutter grade. This reach involves the north side of the conduit from Station 10+60 ± to Station 21+50 ±.

In addition to surface flows, the following existing storm drains that currently discharge into the river will be connected to the new concrete channel:

Station	Material	Size	Inv.
12+00	Tile	12" dia.	366.7
14+25	Cast iron	8" dia.	364.2

Flap gates will not be required on these two lines because of the elevation of their inlets. All drains that are to be connected to the new channel are being checked out by the City Engineer to confirm that they are still in operation.

In Area #1, the existing surcharged storm drains along with substantial overland flow will discharge the 100-year storm runoff as explained hereinbefore with no appreciable damage occurring in the low lying railroad yards. There is no new conduit passing through the protection or new interceptor drain proposed for this area.

(2) Drainage Area #2. - Area #2 is located north of the Still River east of drainage Area #1. The southside of the area is made up mostly of railroad yards separated from the northerly residential area by White Street. The proposed channel protection along this area consists of an open reinforced concrete channel. The watershed, consisting of 158 acres, is approximately 6,500 feet in length with a differential in elevation from 370 to 560 m.s.l. The pattern of overland flow is determined by the area's network of streets. Flows exceeding the limited capacity of the existing storm drains concentrate in a low area south of White Street and west of Durant Street. This is a swampy area interspersed with small streams. There is an existing 2-foot square culvert that carries the buildup of runoff in this low area under the railroad tracks and into the Still River. This culvert has a very limited capacity.

If the proposed channel is constructed with no increase in the size of the culvert connecting this ponding area to the Still River, the new channel will afford little protection to the buildings in this area in the event of a 100-year storm. The water will rise in the ponding area until it reaches Elevation 371 ± at which point it will flow over the tracks to the river. A backup to this elevation will cause substantial damage to the cutlery and box firms located in the area north of the railroad tracks.

At the present time, there is an urban renewal study underway in this area. It is anticipated that work under this project will provide the drain under the railroad tracks necessary to minimize this damage.

Under the local protection project, an opening will be provided in the reinforced concrete channel at Station 35+70 ± that will be capable of passing a 100-year storm into the Still River at low flows. A drainage structure will be connected to the channel wall and an opening for a 25-year storm runoff will be provided on the inlet side anticipating a pipe connection being made under the urban renewal contract. Until this connection is made, this aperture will service flows coming from the 2-foot square culvert under the tracks. A flap gate will be provided inside the structure to prevent backup when the river is flowing at project flood stage. The hydraulic gradient elevation of the river at this point with the project flood is 364.0 ±. Substantial damage is incurred just north of the protection at this station in the vicinity of the swampy area, when water ponds to Elevation 364.4, therefore, it is evident that the system will have to rely on ponding in this relatively low swampy area to store small quantities of runoff during periods when the river is at project flood stage. It is estimated that 4 acre-feet of storage is available at this location. If a large drain is provided under the railroad tracks with the urban renewal contract, relief of this storage can be accomplished expeditiously. The sustained damages will be greater if no new drain is provided in this area.

With the flood of record in the channel, the water elevation would be 362.0 ±. This provides a 2-foot head differential between the damage elevation and the water in the conduit. With the existing 2-foot square culvert, approximately 25 c.f.s. could discharge into the river assuming clear passage in the culvert. If a 60-inch culvert is installed beneath the tracks under the urban renewal project, it is estimated that 200 c.f.s. would discharge into the river. It is recommended that a 72-inch storm drain be provided by the City or under the urban renewal project at this point. This storm drain would prevent water from backing up above the substantial damage elevation of 364.4 during the 100-year storm and it would substantially reduce damages due to runoff during periods of project flood stage and flood of record elevations in the river.

(3) Drainage Area #3. - Area #3 is located on the northside of the Still River. It is bounded by Area #2 to the north and west. It forms the northeasterly boundary of the total area.

The southerly part of the area is constricted in the vicinity of the railroad tracks and Taylor Street. It spreads out from this point to abut the protection from Station 38+00 to Station 47+00 ± left. The southwesterly part of the area is primarily industrial. The larger areas to the north and east are residential with a few commercial establishments included. The watershed consisting of 121 acres is 4,600 ± feet in length with a differential in elevation from 360 to 564 m.s.l. The land contiguous to the protection consists mostly of The Fairfield

Process Company property. The comparatively large number of drains discharging from the buildings of this firm will be picked up in an interceptor and discharged through the wing wall of the protective channel at Station 45+40.

The large drainage contributions in this area are controlled by natural swales, railroad ditches, municipal and private storm drains and a stream located to the east of The Fairfield Process Company buildings. This stream enters the proposed channel at Station 47+00 ±. The ground surface will be regraded as shown on Plate 2-4 at this confluence and a 72-inch pipe with headwalls at each end will carry the runoff to the river. This pipe is sized to handle a 100-year storm with low river flows. With the standard project flood in the river, the available head for storm drainage discharge is estimated at 2.0 ± feet. This would discharge a storm with an intensity-frequency of 5 years. No flap gate will be required on the discharge end of the 72-inch drain.

The proposed urban renewal layout in this area has a 72-inch storm drain from the intersection of Wildman and Austin Streets to Station 47+00 ± at the proposed channel. This construction can easily be coordinated with our proposals. The construction of both the channel protection and the urban renewal project with the coordination of their drainage proposals will provide excellent drainage control in this area if adequate grate inlet capacities are provided.

(4) Drainage Area #4. - Area #4 is a small flat area located in the approximate center of the protective reach. It is contiguous to the protection from Station 36+00 ± to Station 38+00 ± left. The area is made up of small manufacturing buildings and residences. The watershed, consisting of 14 acres, is approximately 800 feet in length with a differential in elevation from 367 to 378 feet m.s.l. The pattern of overland flow is generally in the direction of Chestnut Street and from here into the existing city drains and the river.

The walls of the proposed protection in this area are too high, relative to the existing topography, to permit large storm runoff from going into the river over depressions along the top of the wall as proposed in other areas. The 100-year storm in this area will have to be picked up at an existing depression with a large grating and piped (24-inch drain) along with the existing 15-inch storm drain through the protection.

With the standard project flood in the river, the water elevation would be 363.8 ±. With a damage elevation of 365.5, the available head for storm drain discharge at this design flow would be 1.7. This head along with the proposed 24-inch and existing 15-inch drains

should make it possible to discharge a storm with a 3-year frequency-intensity.

The urban renewal proposals for storm drainage in this area will not conflict with anything discussed hereinbefore. The only new work under this project will be a drain discharging catch basins from a new highway proposed about 170 feet ± north of the existing Chestnut Street. This drain can be connected to the reinforced concrete protective channel and will supplement those proposed for construction under this project.

(5) Drainage Area #5. - Area #5 is located north of the Still River on the downstream end of the project. The American Cyanamid and Empire Products Companies cover the southerly portion. The remainder is made up of small business establishments and residences. The area is bounded on the north by the New Haven railroad tracks, on the east by Triangle Street, on the south by the proposed dike for channel protection, and on the west by an existing stream that carries the storm drainage from Area #3 to the river. The watershed consisting of 32 acres is 1,500 ± feet in length with a differential in elevation from 355 to 368 feet m.s.l. The pattern of overland flow in this area will be disrupted by the river relocation (see Plate 2-12). The existing river channel will be filled and graded to direct all surface flows to a new storm drain line that will discharge to the river around Station 61+00 ±. This line will approximately follow the alignment of the existing river. All existing storm and building drains that heretofore discharged to the river will be tied into the new drain. Another new drain will be added in the vicinity of Station 62+00 ± to relieve a depression. There is an existing 18-inch drain at Station 66+00.

With a standard project flood in the river, the water elevation at the discharge end of the new drains will be 359.2 ±. They, along with the existing drain, will be provided with flap gates to prevent the river from backing into the low-lying areas on the landside of the dike. The topography indicates that some landside areas would be inundated at this time if the gates stuck, but no serious damage will occur until water starts getting into the Empire Products Plant, the floor elevation of which is 359.3. This elevation and the water elevation in the river indicate that any storm drain runoff at this time would build up on the landside of the dike and the Empire Products Company would begin incurring damages in proportion to the storm. There is a ponding area available in this area (land lower than Elevation 353.3) that would provide storage for a short period of time while the river is at design stage.

With the flood of record flowing in the reconstructed channel, the water surface elevation would be 356.7 ±. This head differential of 2.6 ± feet with an estimated pipe discharge area of 12 square feet, would discharge approximately 50 c.f.s. or a storm with a frequency-intensity of around 2 years. With low water in the river, a 100-year storm and the new and existing pipes available, the runoff could be discharged with no damage and a minimum of ponding on the landside of the dikes.

(6) Drainage Area #6. - Area #6 is located southeast of the railroad bridge that crosses Still River at the upstream end of the project. The outside of the area consists of railroad yards and the Daddario Concrete Plant. The southerly part of the drainage area is primarily residential. Main Street runs in a northwesterly direction through the center of the area. The proposed protection will be connected to the existing reinforced concrete channel constructed under a recent City contract. The watershed, consisting of 161 acres, is 3,100 ± feet in length with a differential in elevation from 370 to 484 feet m.s.l. The pattern of overland flow is determined by the large flat areas between the relatively high and parallel Main Street and Nichols Town Hill Avenue. Flow in this area is in a westerly direction and is picked up in a 42-inch trunk drain that flows under Keeler Street and then to the river discharging 1,000 ± feet east of the intersection of White Street and the river.

The urban renewal layout in this area proposes to pick up the existing 42-inch storm drain on Liberty Street, and relocate its discharge line with a 48-inch pipe under a proposed north-south highway with discharge to the river 400 ± feet east of the river's intersection with White Street.

It is proposed under the local protection project to provide a structure with flap gate at the channel wall and connect it to the existing 42-inch drain at Station 15+70 right. The opening to the river in this structure will pass a 100-year storm of low water. A knockout will be provided in the wall of the protection where it is proposed to discharge the 48-inch drain under the urban renewal contract. The ground elevation on the low area adjacent to the channel after grading is at Elevation 369.5 ± south. The overflow will run over existing streets and into the railroad yards. From here, the water will go directly over the side of the concrete channel at depressed points along the wall. This means of discharge will handle a 100-year storm without any damaging buildup in the area abutting the protection.

With the river running at standard project flood (Elevation 365.5 ±), it is estimated that the existing drainage system in the

area would only be capable of handling something less than a two-year storm. All residual flows would be overland to the railroad yards and over the channel walls. The low area in the yards is 369.5 ±. No serious damage will occur in this area from overland flows. With the urban renewal contract completed, the situation would differ somewhat. All overland flows would have to be analyzed in conjunction with the revised topography. The storm drainage effluent line would be increased to a 48-inch and discharged west of the railroad bridge.

(7) Drainage Area #7. - Area #7 is located on the south side of the Still River between drainage area #6 and #8. The north side of the area consists of railroad yards and the grounds and buildings of The Connecticut Light and Power Company. The southerly part of the area is primarily residential. The watershed, consisting of 27 acres, is 1,300 ± feet in length with a differential in elevation from 370 to 432 feet m.s.l. The pattern of overland flow is determined by the street network and the existing storm drain layout. The 18-inch discharge line for the existing storm drainage system runs under the northerly end of Nichols Town Hill Avenue and discharges into the river at Station 22+55 right.

The urban renewal layout in this area proposes to replace the existing 18-inch drain with a 30-inch and keep the alignment the same. At this time, the existing 18-inch drain will be extended to the protective channel. A knockout will be provided to facilitate connection of a 30-inch pipe under the urban renewal contract. In addition to the 18-inch drain indicated above, another 18-inch drain at Station 23+10 ± right is indicated on the topography sheets. The origin of this drain is not clear, but if it is still active, it will be extended to the protection for discharge.

With a 100-year storm runoff and low river stage (Q = 139 c.f.s.), the existing 18-inch drain will be surcharged with an estimated discharge of 20 c.f.s. The remainder of runoff will flow overland and eventually discharge into the low areas of the railroad yards. There will be no appreciable or damaging buildup in this area because of the depressions that will be provided along the top of the wall of the protective channel to relieve this surface flow.

With the river running at standard project flood (Elevation 365.5 ±), it is estimated that the existing drainage system would only be capable of handling a storm with a frequency of less than a year. With more severe storms under this condition, the balance of runoff would be to the railroad yards and from this point it would be relieved by the depressions on top of the channel wall. It is estimated that storms with up to a two-year frequency-intensity would cause little or no damage at this time.

With the urban renewal contract completed, the topography of the area could be changed significantly. All overland flows would have to be analyzed in conjunction with new storm drainage layouts and road grades.

(8) Drainage Area #8. - Area #8 is located south and west of the Still River between areas #7 and #9. The north side of the area is occupied by data processing establishments with the center and southerly parts of the area primarily residential. The watershed, consisting of 34 acres, is 2,100 ± feet in length with a differential in elevation from 370 to 447 feet m.s.l. The area is presently serviced by a system of storm drains which discharge into the river. Some of the existing drains in the northerly area will be picked up by a proposed interceptor drain running parallel with the protection and discharging at Station 29+50 ± right in the protective channel. Drainage structures on this line will have grates to help handle surface flows. A special drainage structure connecting the interceptor drain to the wall of the river conduit will terminate the downstream end of the line. The remainder of the existing drains to the river in this area will be made with separate connections through the protective wall and dike. The elevations of the channel wall abutting this area are substantially higher than some of the low ground indicated on the topography. For this reason, two structures with 36-inch discharge pipes to the river will be located at the depressions. Flap gates will be provided on the ends of these lines.

With the river running at standard project flood (Elevations 365.2 ± to 360.5 ± along the reach abutting the floodwall), it is estimated that the existing drainage system in the area would only be capable of handling something less than a two-year storm. All overland flows resulting from larger storms would pond in depressed areas with minimum damage. With low water in the river and a 100-year storm, the overland flow would be relieved with the new and existing drains because of the large discharge head available.

The proposed urban renewal layout in this area will have little or no effect on the drainage proposals under the local protection project. There are no new lines connecting to the river in this area under urban renewal. They propose to modify the existing drainage system without revising the existing discharge lines.

(9) Drainage Area #9. - Area #9 is located south of the Still River on the downstream end of the project. The Republic Foil property covers the northeast section of this drainage area with the remainder being primarily residential. The watershed, consisting of 50 acres, is 1,500 ± feet in length with a differential in elevation

from 362 to 453 m.s.l. Where the area abuts the proposed protective alignment, there are city and private drains discharging to the river. These drains will be cut off or extended where they intersect the proposed dike slope. Inlets will be provided where the dike cuts off normal overland flow to the river.

With the river running at standard project flood level (average elevation 359.3 ± for this area), the capacity for discharging storm runoff will depend on the opening sized for a 100-year storm runoff with low river as required by criteria. When a storm occurs coincident with this flow, the intensity-frequency of the storm that will cause damage will depend on (1) the ponding area available, (2) its average depth, and (3) the available areaway of drains and grates for discharge to the river. The ponding area and depth will depend on the elevation at which serious damage begins to occur. This elevation is around 362.0 ± at this location. It indicates that no damage will result from water backing up through drains from the river thereby eliminating flap gate requirements. It does provide an indicator of the ponding capacity of the area and it allows a differential head of ± 2.5 feet that is available to push runoff ponding behind the protection into the river. Computations indicate that the total areaway opening required to relieve a 100-year storm (133 c.f.s.) with low water in the river and free discharge would be 8.0 ± square feet. A new 36-inch drain with a sizable inlet in addition to the existing drains will pass this storm through the protection. With this areaway available and a head of 2.5 feet of standard project flood, 60 c.f.s. could be discharged through this opening. This would be the approximate equivalent of a 2-year storm.

The urban renewal project as currently outlined does not cover this drainage area. The only coordination required for storm drain work in the area will be with city drains and the private lines discharging from local firms.

h. Estimated Costs. - The estimated cost of the required storm drainage system is $92,240.

40. UTILITIES. -

a. General. - The layout of existing utilities in the area of proposed construction along with all the new utility lines are shown on Plates 2-11 and 2-12. Detailed information showing elevations, sizes and modifications will appear on contract drawings.

TABLE 2-1

INTERIOR DRAINAGE DESIGN DISCHARGES AND RATIONAL FORMULA DATA

AREA No.	D.A (Acres)	COMPOSITE INFILTRATION FACTOR	TIME OF CONCENTRATION	100-YR. RAINFALL RATE in/hr.	10-YR. RAINFALL RATE in/hr.	100-YR. Q cfs	10-YR. Q cfs
1	17	.7	20	5.7	3.8	97	65
2	158	.5	40	4.1	2.9	648	458
3	121	.6	40	4.1	2.9	496	351
4	9	.5	20	5.7	3.8	52	34
5	32	.6	25	5.1	3.4	163	109
6	161	.6	40	4.1	2.9	660	466
7	27	.6	25	5.1	3.4	135	92
8	34	.6	25	5.1	3.4	174	116
9	50	.5	30	4.8	3.1	240	155

b. Public Utilities. -

(1) Sanitary Sewers. - The existing municipal sanitary sewer system and proposed relocations are shown on Plates 2-11 and 2-12. The existing 36-inch truck line in the vicinity of the protection from Station 9+50 ± to Station 38+00 ± will be relocated as a 42-inch sewer along the north side of the protection for this reach. The alignment of this sewer has been coordinated with preliminary urban renewal plans. The funding of this line is considered to be a relocation cost and therefore, the financial obligation of the city.

In addition to the relocation of the truck sewer, there are 4 existing sanitary lines crossing the proposed protection. These lines will be redesigned as siphons where they cross under the new channel. The data on these lines is as follows:

Station	Diameter	Length
16+00	15"	240'
22+00	18"	125'
37+50	12"	140'
60+60	12"	320'

Another item of sewer work involved with the protection will be the placement of the 8-inch sanitary line across the new Casper Street bridge.

The estimated cost of the required sanitary sewer system is $253,000.

(2) Water. - Danbury has a municipal water system. The lines in the vicinity of the proposed construction requiring relocation are:

(a) A 6-inch line under the existing Chestnut Street bridge across the Still River.

(b) An 8-inch line under the Still River 100 ± feet south of the above line.

(c) A 12-inch line on Casper Street. This line will be slung from the new bridge across the relocated river.

The estimated cost of the required water lines is $2,600.

(3) Storm Drains. - New storm drain lines and modifications to the existing system are covered in Paragraph 39, Interior Drainage.

(4) Highway Bridges. - The location and project proposal are described in Paragraph 25d above. The cost of the work is estimated to be $192,200.

c. Private Utilities. -

(1) Gas. - Gas service for Danbury is provided by the Connecticut Light and Power Company. Existing gas lines in the vicinity of the construction requiring relocation are:

(a) A 10-inch high pressure line under the existing Chestnut Street bridge across the Still River.

(b) A 9-inch high pressure and 3-inch low pressure line on Casper Street. These lines will be slung from the new bridge across the relocated river. The lines on the existing bridge will be moved to suit the new grades when the bridge is removed.

The 9-inch and 10-inch gas lines mentioned above are transmission lines, and must be kept in operation with temporary bypasses during their relocation.

(2) Electric and Telephone. -

(a) Relocate 15 poles and approximately 12,000 feet of 3 and 6W primary, telephone cables and signal wires along railroad yard between White and Chestnut Streets.

(b) Relocate telephone and electric duct line and telephone manhole for new Chestnut Street bridge.

(c) Relocate 3 poles and approximately 1,000 feet primary, secondary, street lighting, telephone cables and signal wires south of Chestnut Street.

(d) Relocate 3 poles and approximately 330 feet primary, secondary, street lighting and telephone cables along Casper Street.

(e) Relocate 2 poles, parking area - Republic Foil, Inc., west of Triangle Street.

(f) Relocate pole and 6 guys for telephone and electric lines, east of Triangle Street.

The cost of this work is estimated to be: lighting $200, electric lines $38,000, and telephone lines $20,000.

Proposed future transmission lines of Connecticut Light and Power Company being designed to miss new channel at no additional cost.

(3) Railroad. - In connection with the railroad bridge and channel work, approximately 2,000 feet of railroad track as well as signal lines within the railroad yard which will require relocation. The cost of this work is estimated to be $55,000.

41. RELOCATIONS COST RECAPITULATION.

a.	**Utilities**	
	Storm Drains	$92,240
	Water	2,600
	Gas	5,500
	Sewer	253,000
		$ 353,340
	Contingencies 15% ±	52,660
		406,000
	Engineering and Design 8%	32,000
		438,000
	Supervision & Administration 6%	27,000
		$465,000
b.	**Electric and Telephone**	
	Lighting	$200
	Electric Lines	38,000
	Telephone	20,000
		$58,200
	Contingencies 15%	8,800
		67,000
	Engineering and Design	2,000
		69,000
	Supervision & Administration	2,000
		$71,000
c.	**Highway Bridges**	$192,200
	Contingencies 15%	28,800
		221,000
	Engineering and Design 8%	18,000
		239,000
	Supervision and Administration 6%	14,000
		$253,000

d. Railroad

Track	$50,000
Signal Lines	5,000
	$55,000
Contingencies 15%	8,000
	63,000
Engineering and Design 8%	5,000
	68,000
Supervision and Administration 6%	4,000
	$72,000

Q. COST ESTIMATES

42. ESTIMATES OF COST. - The estimated cost is as follows:

FIRST COST
(1969 Base)

Item	Quantity	Unit	Unit Price	Amount	Total Amount
NON-FEDERAL COST					
Lands and Damages					$300,000
Relocations					
Utilities				411,540	
Contingencies				60,460	
Engineering & Design				34,000	
Supervision & Administration				29,000	
					535,000
Railroad				55,000	
Contingencies				8,000	
Engineering & Design				5,000	
Supervision & Administration				4,000	
					72,000
Highway Bridges				192,200	
Contingencies				28,800	
Engineering & Design				18,000	
Supervision & Administration				14,000	
					253,000
TOTAL NON-FEDERAL COSTS					$1,160,000
FEDERAL COST					
Railroad Bridges					
Care & Maintenance of Existing R.R. Bridges During Construction		L.S.		100,000	

Item	Quantity	Unit	Unit Price	Amount	Total Amount
R.R. Track	860	L.F.	25.00	21,500	
R.R. Bridge #26.40, Remove R.R. Bridge #26.06, Remove R.R. Bridge #25.69, Remove		L.S.		25,000	
R.R. Bridge #25.14, Remove and Reconstruct		L.S.		150,000	
R.R. Bridges				296,500	
Contingencies				44,500	
				341,000	
Engineering & Design				17,000	
Supervision & Administration				22,000	
TOTAL R.R. BRIDGES					380,000 300,000
Channels & Canals					
Preparation of Site	20	Ac.	500	10,000	
Stream Control		L.S.		275,000	
Structure Removal		L.S.		10,000	
Excavation, General	210,000	C.Y.	1.75	367,500	
Excavation, Rock	100	C.Y.	8.00	800	
Stone Protection	11,500	C.Y.	17.00	195,500	
1½" Crushed Stone	1,000	C.Y.	7.50	7,500	
Gravel Bedding	19,000	C.Y.	4.00	76,000	
Compacted Gravel Fill	7,000	C.Y.	3.75	26,250	
Uncompacted Processed Gravel	5,400	C.Y.	4.00	21,600	
Dumped Process Gravel	650	C.Y.	3.50	2,275	
Compacted Process Sand	2,600	C.Y.	5.00	13,000	
Dumped Process Sand	4,600	C.Y.	4.50	20,700	
Uncompacted Earth Fill	6,700	C.Y.	.75	5,025	
Compacted Earth Fill	60,400	C.Y.	1.75	45,300	
Channel Fill	16,000	C.Y.	.50	8,000	
6" Topsoil, Seeded	7,500	S.Y.	1.00	7,500	
Concrete	24,600	C.Y.	60.00	1,476,000	
Reinforcing Steel	2,460,000	LBS	.17	418,200	
Cement	36,900	BBL	5.00	184,500	

Item	Quantity	Unit	Unit Price	Amount	Total Amount
Steel Sheet Piling, Permanent	1,300	S.F.	6.00	7,800	
Const. Sheet Piling, Temporary	103,500	S.F.	3.50	362,250	
6" BCCMP	1,100	L.F.	4.00	4,400	
8" BCCMP Perf.	7,300	L.F.	5.00	36,500	
12" BCCMP	5,100	L.F.	6.00	30,600	
6' Chain Link Fence	6,700	L.F.	6.00	33,500	
Shoring	1,800	L.F.	6.00	10,800	
Manhole	14	EA.	700.00	9,800	
Drainage Structure	7	EA.	5,000.00	35,000	
36" Flap Gate	1	EA.	1,000.00	1,000	
				3,702,300	
Contingencies				555,700	
				4,258,000	
Engineering & Design				350,000	
Supervision & Administration				282,000	
TOTAL CHANNELS & CANALS					$4,890,000
TOTAL FEDERAL COST					
R.R. Bridges -				$380,000	
Channels & Canals -				4,890,000	
				$5,270,000	
TOTAL PROJECT CONSTRUCTION COSTS					$6,430,000

43. COMPARISON OF ESTIMATES. - The following tabulation indicates the comparison of the current cost estimate with the latest approved PB-3 cost estimate and with the project document estimate.

Cost Account Number	Item	Current Estimate (Jan 69)	PB-3 Estimate (July 68)	Project Document Estimate (Sept 1963)
02.	Relocations	$390,000 [1]	$510,000	$690,000
.2	Railroads	(390,000) 380,000	(510,000)	(690,000)
09.	Channels & Canals	4,258,000[2]	2,680,000	1,293,000
30.	Engineering & Design	340,000 350,000	335,000	197,000
31.	Supervision & Administration	282,000	225,000	120,000
	TOTAL FEDERAL COST	5,270,000	3,750,000	2,300,000
	NON-FEDERAL COSTS			
01.	Lands & Damages	300,000	300,000	340,000
02.	Relocations	860,000[2]	280,000	310,000
.1	Roads (Incl. Bridges)	(253,000)	(220,000)	(243,000)
.2	Railroads	(72,000)		
.3	Utilities	(535,000)	(60,000)	(67,000)
	TOTAL NON-FEDERAL COST	$1,160,000	$580,000	$650,000
	TOTAL ESTIMATED PROJECT COST	$6,430,000	$4,330,000	$2,950,000

1. Decrease due to change in lengths and type of railroad channel crossings.

2. Increase due to detailed design studies, utilizing new site surveys, and foundation exploration data indicated more complex and expensive construction. These include changes in items of work, unit quantities, and unit prices, (Based on recent Bid Openings). The studies indicated a marked increase in utility relocations for the Non-Federal Interests, (sewers, storm drains and R.R. track).

44. COST OF TRAPEZOIDAL CHANNEL. - The following tabulation when compared with the current project cost estimate of preceding tabulation indicates the economic justification for changing from the original project plan of improved trapezoidal channel to the project plan.

Cost Account No.		Trapezoidal Estimate (Jan 1969)	
FEDERAL COST			
02.	Relocations	$1,273,000	
	Railroads	(1,273,000)	1,250.0
09.	Channels & Canals	3,394,000	3,394.0
30.	Engineering & Design	315,000	325 (mid stream)
31.	Supervision & Administration	220,000	250
	TOTAL FEDERAL COSTS	$5,202,000	5,219
NON-FEDERAL COST			
01.	Lands & Damages	$610,000	610.0
02.	Relocations	$1,018,000	1009.0
	Roads (Incl. Bridges)	(454,000)	(459.0)
	Utilities	(564,000)	(550.0)
	TOTAL NON-FEDERAL COST	$1,628,000	1,619.0
	TOTAL PROJECT COST	$6,830,000	6,838.0

An overall project saving of $400,000.

R. SCHEDULE OF DESIGN AND CONSTRUCTION

45. DESIGN. - Contract plans and specifications are scheduled for completion in June 1969.

46. CONSTRUCTION. - It is estimated that twenty-four months will be required for construction. It is proposed to consolidate all work under one contract.

47. FUNDS REQUIRED. - The construction schedule is based on funds being available in F.Y. 1970 and that additional funds will be appropriated in ensuing years as required. Accordingly, it is estimated that funds will be required by construction year approximately as follows:

	Fiscal Year	Construction Year	Construction Schedule
TOTAL TO:	1969		$257,000
		1	400,000
		2	2,600,000
		3	2,013,000
TOTAL FEDERAL FUNDS			$5,270,000

The construction schedule and yearly appropriation required is included as Plate No. 2-13.

S. MAINTENANCE AND OPERATION

48. MAINTENANCE AND OPERATION. - Maintenance and operation of the project is the responsibility of the city of Danbury. The project will be maintained and operated in accordance with the project Operation and Maintenance Manual.

T. ECONOMICS

49. GENERAL. - A review of the flood losses in Danbury was made early in February 1968. The review consisted of a door to door canvass of all properties in the flood plain and interviews with owners and managers of properties to determine what changes, if any, in plant and equipment and stock subject to flood damage had taken place since the 1962 damage review. Information was also sought on current trends and on future plans for properties. Redevelopment officials were interviewed and other interested community leaders were also contacted.

50. CURRENT CONDITIONS. - For the area from White Street to Chestnut Street with one exception there has been an upgrading of properties (mainly commercial) and an increase in the loss potential. The exception was a fur factory which recently closed representing a decrease in recurring losses of $161,000 for this reach. The removal of this property from the loss summary was more than offset by the addition of three new properties in the flood plain, the largest of which is a transit mix concrete and asphaltic concrete mixing plant. A change in use in two other properties has increased recurring losses and the inventory subject to flood damage in four other properties is substantially higher. Recurring losses for the entire reach are 24% higher than in 1962.

In the area from Chestnut Street to Triangle Street, increased industrial activity with an expansion of equipment, inventories and payrolls has caused an increase of 29.7% in recurring losses in the fifteen manufacturing plants in the reach. One plant had already added a separate 18,000 sq. ft. structure for warehousing.

51. TRENDS OF DEVELOPMENT. - The economic climate of Danbury is vastly different today than it was at the time of the 1962 study. At that time the two largest hat factories in the city had closed down production and this in turn was reflected in reduced activities in the fur companies in Danbury who were suppliers for the plants. In 1962 traffic was a major problem especially in the city's center.

The construction of Interstate Route I-84 which skirts the western and northern edge of Danbury has removed all of the through traffic which clogged Danbury's center in 1962. Construction carried on under the Urban Renewal project has revised the street layout and improved the traffic pattern at the center of the city as well as supplying a large amount of much needed parking space.

I-84 is now complete in Connecticut from the New York State line to New Britain, about 11 miles from Hartford and the uncompleted section is under construction. To the south, new Route 7, an expressway which will connect Danbury with I-95 in Norwalk, is under construction. In Bridgeport another expressway, Route 25 is under construction, again to connect with Danbury. This city, thus will soon enjoy fast, convenient highway access to all the major cities in Connecticut and eastern New York. It already has rail service both east-west and north-south. So situated, the city is a natural site for industrial plants whose output is regionally oriented.

As noted there has been a substantial increase in industrial activity in the flood plain since 1962. At the time of the February 1968 review it was announced that:

a. A large manufacturer of optical instruments was opening a plant in Danbury which would have an employment of 1300 people by year's end (Perkin$-Elmer).

b. One of the large hat factories which had closed in 1962 was reopening and was hiring help (The Mallory Hat Division of the John B. Stetson Company).

52. FUTURE DEVELOPMENT. - Danbury is one of the fastest growing cities in Connecticut. Between 1960 and 1965 it had a growth of 17% in population, a rate that exceeds that of Fairfield County as a whole by over 2%. Fairfield County itself has the highest growth rate in the State with the exception of Tolland County, a predominantly rural county adjoining Hartford County to the east which is beginning to be impinged on by the Hartford SMSA. According to data from the Connecticut Labor Department, the Danbury Labor Market area had an increase in population of 27% in the period 1960-1965. This growth in population is sure to continue.

The projected growth will mean a continuing pressure for highest usage of the flood plain. The coming of the Perkin$-Elmer plant will bring additional work to two service type industries located in the Chestnut to Triangle Street reach. The reopening of Mallory Hat will mean increased activities for six plants in the flood plain which make the fur-felt used in hats or make rough hats for finishing by others. It could even result in the reopening of the fur factory noted in the White Street-Chestnut Street reach.

In addition to the above, two of the larger plants in the reach below Chestnut Street plan expansions upon project completion. These are known elements of growth.

It is noted that some four acres of land suitable for industrial use will be created by the channel alinement in the reach from Casper Street to Chestnut Street. With suitable land in Danbury already in short supply this land is forecast to be in industrial use within five years of project completion. Adjustments were made in annual losses (and benefits) to reflect these expected changes.

In spite of the loss of the one older fur factory (which is forecast to be put to some other use in the future) loss potential in the White Street-Chestnut Street reach has increased by 24.7% in the past five years. With the ready access provided by the new traffic pattern and adequate adjacent offstreet parking there will be a continuing increase in the economic activity of this primarily commercial area. The result will be higher inventories and increased employment adding further to the loss potential. Losses are projected to increase by 18% by 1972, 40% by 1980, and 75% by the year 2000 at which time they will level off. The slower rate of growth in the period 1980-2000 reflects the amount of present development and the finite limits of the area. The project is to be completed in 1972 and this is taken as the base year for benefit analysis. The growth from 1972 to 1980 and 1980 to 2000 discounted at an interest rate of 3¼% has an average annual equivalent value over a 100 year life of 40.24%.

For the industrial properties in the reach from Chestnut to Triangle Street losses are projected to grow at a rate in consonance with the growth in damage potential during the past five years. They will have increased 20% by 1972, 50% by 1980 and by 80% by the year 2000. In addition, a factory, equivalent to one of the medium size plants in the area, is projected to occupy the four acre tract made available by construction. The growth in loss potential in existing plants due to additions and increased economic activity was discounted to an average annual equivalent value using a

discount rate of 3.25%. The annual equivalent value is an increase of 43.7% in the loss potential. For the projected future plant, annual losses would amount to $8300 based on a nearby plant in the flood plain. Discounted for the 5 year period after project completion the loss would be $7800. Total average annual losses under conditions expected over the project life amounts to $276,000 for the entire area affected by the project.

53. ANNUAL BENEFITS. - Average annual flood damage prevention benefits over the project life amount to $224,000 for the reach from White Street to Triangle Street. Additional benefits of $11,000 annually are realized in the Urban Renewal Area upstream of White Street from the effects of the project on the channel work done under Urban Renewal. Downstream of Triangle Street the replacement of the railroad bridge will make the State channel job more effective and benefits of $3000 annually accrue to the project. Total average annual benefits credited to the project amount to $238,000.

Additional benefits are expected to accrue to the project from the land made available in the New Haven Railroad's yard over that required in the project document. The New Haven, which has been in bankruptcy, is currently being included in the Penn-Central merger. When details are available as to what trackage and other facilities will be located at Danbury under the merged railroad plan it will be possible to quantify the benefits in this area.

54. MAXIMIZED ANNUAL BENEFITS. - Studies indicate that the annual benefits will be maximized for a project design flood of 5,000 c.f.s. However, this portion of the Still River Channel Improvement is the final link of the Still River Improvement within the City of Danbury. The Central Flood Urban Renewal Project has made the channel improvement immediately upstream and contiguous to our project. The State of Connecticut Improved Channel is also contiguous immediately downstream of our project. Both of these projects have been designed and constructed on the basis of the Standard Project Flood flow of 6,900 c.f.s. Our project is in the heart of the densely populated, industrialized City of Danbury and to design for less than the 6,900 c.f.s. would be poor engineering judgment. Accordingly, the project is designed for the Standard Project Flood of 6,900 c.f.s.

55. ANNUAL COSTS. - Total annual charges amounting to $220,000 are summarized as follows:

ESTIMATED ANNUAL CHARGES
(100-Year Life)
LOCAL PROTECTION WORK
DANBURY LOCAL PROTECTION PROJECT, CONN.
STILL RIVER
HOUSATONIC RIVER BASIN
GENERAL DESIGN MEMORANDUM

Item No.	Item	Cost	Total Cost
1.	FEDERAL INVESTMENT		
	Federal First Cost	$5,270,000	
	Interest During Construction	* 0	
	TOTAL FEDERAL INVESTMENT	$5,270,000	
2.	FEDERAL ANNUAL CHARGES		
	Interest (@ 0.0325)	171,300	
	Amortization (@0.00138)	7,300	
	TOTAL FEDERAL ANNUAL CHARGES		$178,600
3.	NON-FEDERAL INVESTMENT		
	Lands, Easements & Rights-of-Way	300,000	
	Improvements	860,000	
	TOTAL NON-FEDERAL FIRST COST	$1,160,000	
	TOTAL NON-FEDERAL INVESTMENT	1,160,000	
4.	NON-FEDERAL ANNUAL CHARGES		
	Interest (@ 0.0325)	37,700	
	Amortization (@ 0.00138)	1,600	
	Maintenance and Operation	2,100	
	TOTAL NON-FEDERAL ANNUAL CHARGES		41,400
5.	TOTAL ANNUAL CHARGES		220,000
6.	TOTAL ANNUAL BENEFITS		$238,000

245,000 6.5%

*Project will be operational before end of two year period, therefore no interest is charged.

BENEFIT-COST RATIO. - The ratio of benefit to cost is 1.08 to 1.

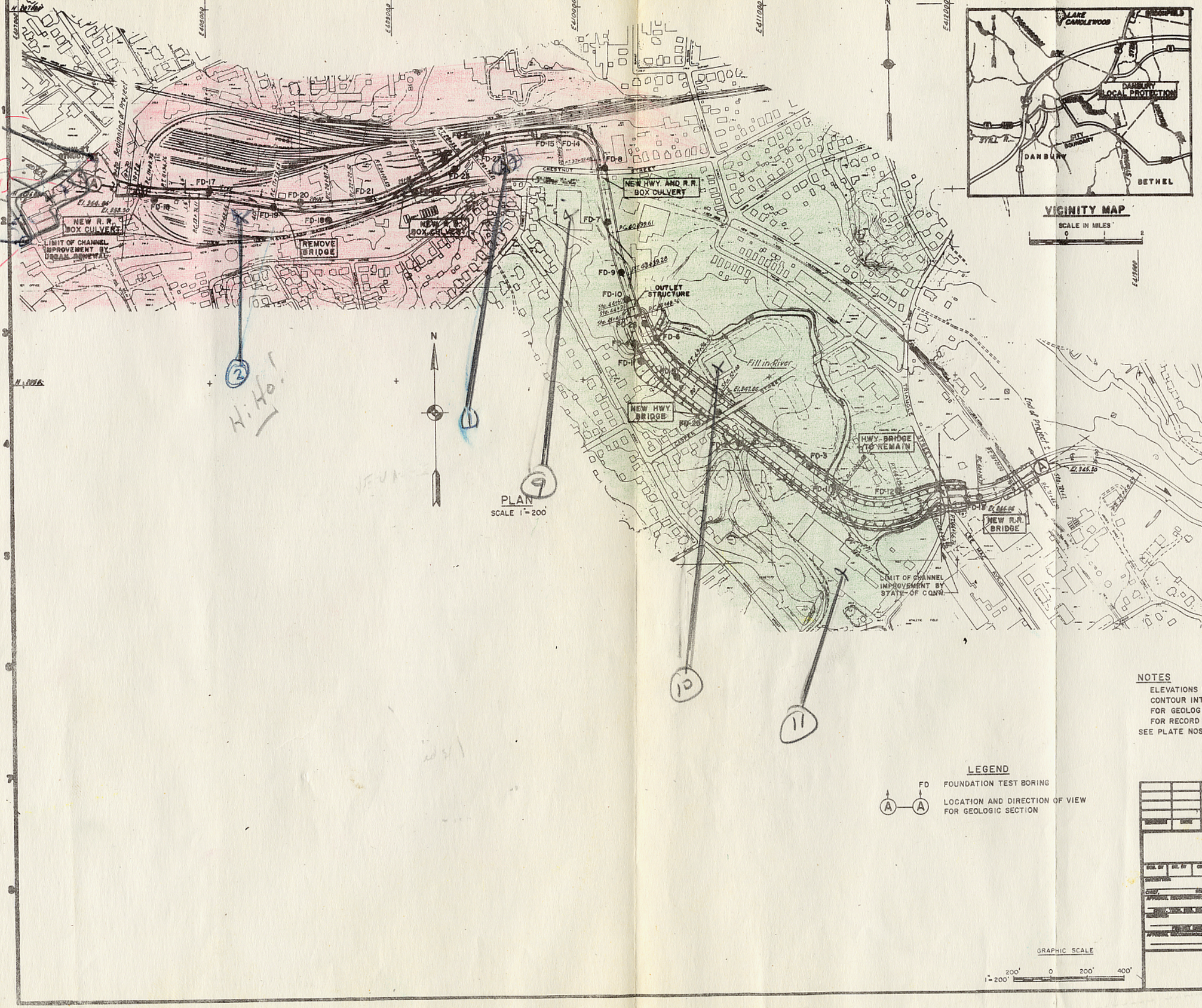
U. COORDINATION WITH OTHER AGENCIES

56. COORDINATION WITH OTHER AGENCIES. - Copies of letters commenting on the project from Federal and State agencies are included in this report under Appendix B.

V. RECOMMENDATION

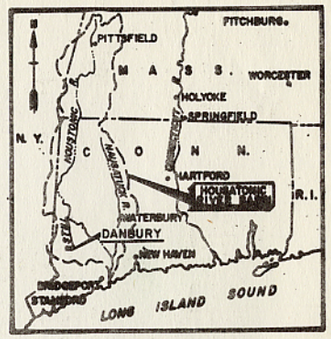
57. RECOMMENDATION. - It is recommended that the project plan presented in this report be approved as the basis for further design and preparation of contract plans and specifications for the Local Protection Project, Danbury, Connecticut.

CORPS OF ENGINEERS — U.S. ARMY



PLAN
SCALE 1" = 200'

VICINITY MAP
SCALE IN MILES
1 0 1 2



LOCATION MAP
SCALE IN MILES
10 0 10 20

NOTES
ELEVATIONS REFER TO MEAN SEA LEVEL DATUM
CONTOUR INTERVAL IS 10 FEET
FOR GEOLOGIC SECTION SEE PLATE NO. 2-7
FOR RECORD OF FOUNDATION EXPLORATIONS
SEE PLATE NOS. 2-8 & 2-9

LEGEND
FD FOUNDATION TEST BORING
(A)—(A) LOCATION AND DIRECTION OF VIEW FOR GEOLOGIC SECTION

GRAPHIC SCALE
1"=200' 200' 0 200' 400'

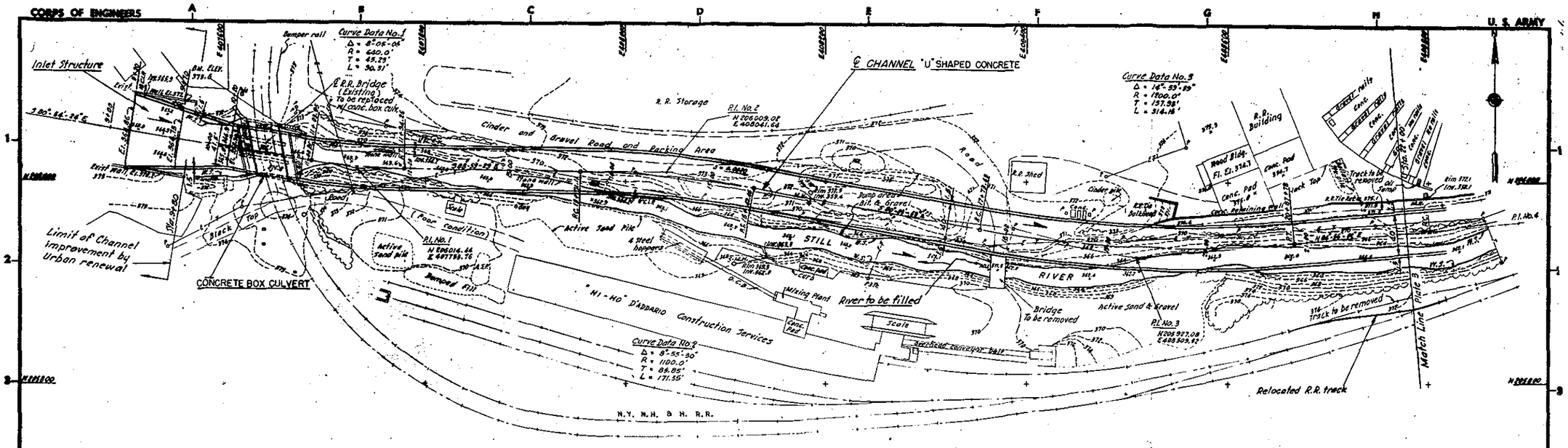
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
GENERAL PLAN
AND
PLAN OF FOUNDATION EXPLORATIONS
STILL RIVER CONNECTICUT

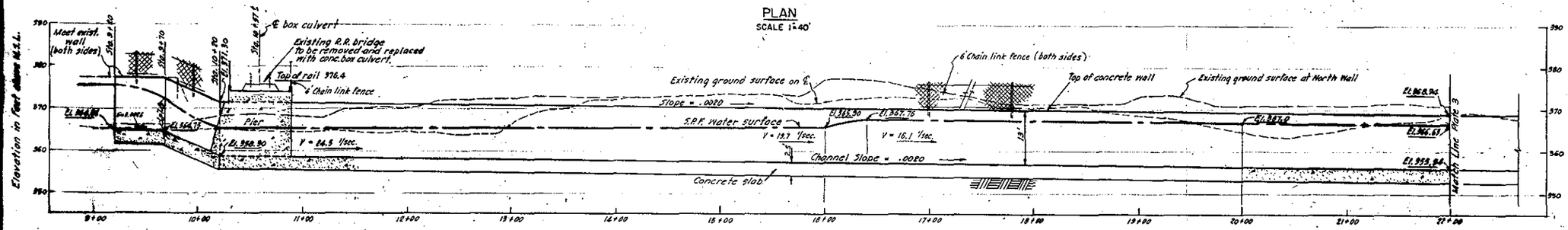
SCALE 1"=200' SHT. NO. HOU- SHEET

PLATE NO. 2-1

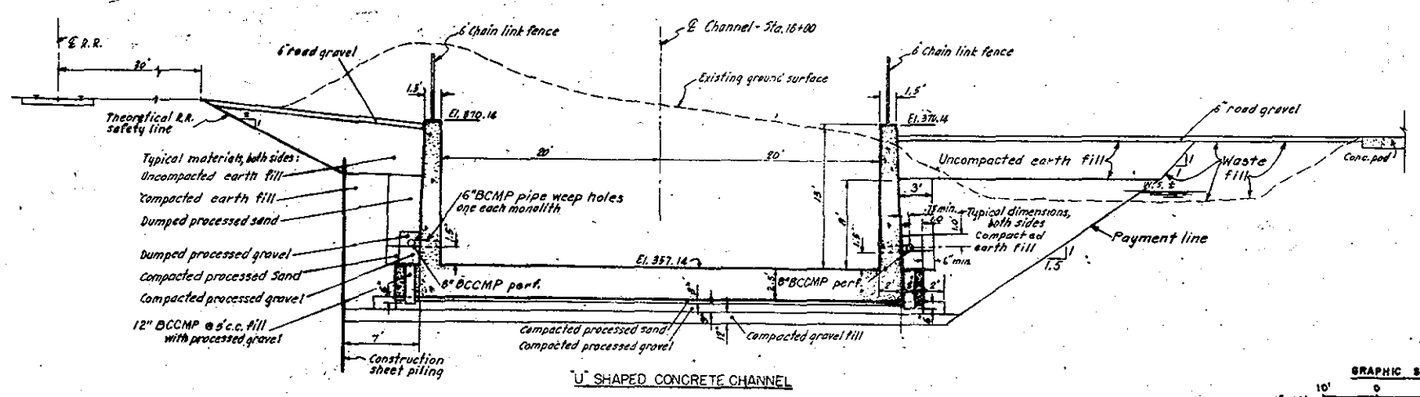
CORPS OF ENGINEERS — U. S. ARMY



PLAN
SCALE 1"=40'



PROFILE ON ℄ OF CHANNEL
SCALE HOR. 1"=40'
VERT. 1"=10'



"U" SHAPED CONCRETE CHANNEL
TYPICAL SECTION
SCALE 1"=5'

NOTES
For typical section of concrete box culvert, see Plate No. 2-3.

SAFETY PAYS

GRAPHIC SCALES
1"=10' — 10' 0 10' 20'
1"=40' — 40' 0 40' 80'
1"=5' — 5' 0 5' 10'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
PLAN AND PROFILE NO. 1
STA. 9+20 TO STA. 22+00
STILL RIVER, CONNECTICUT

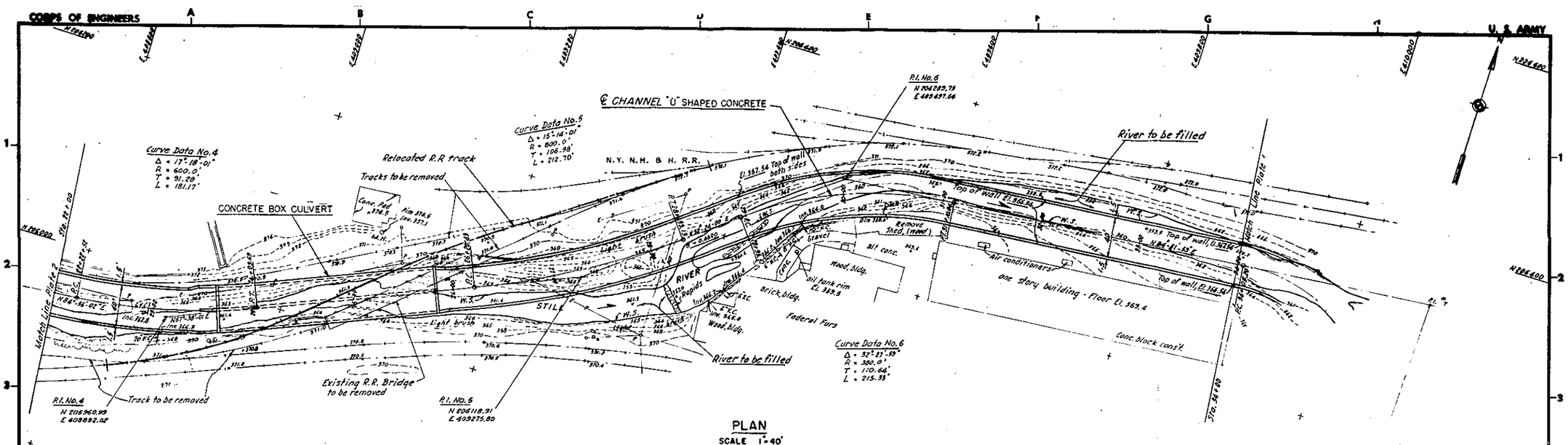
SCALES AS SHOWN — SPEC. NO. CIV. ENG. 55-005-

SHEET

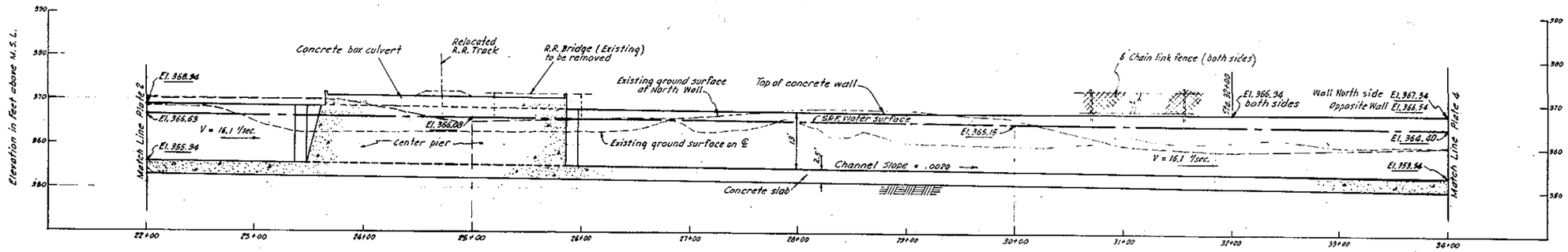
PLATE NO. 2-2

CORPS OF ENGINEERS

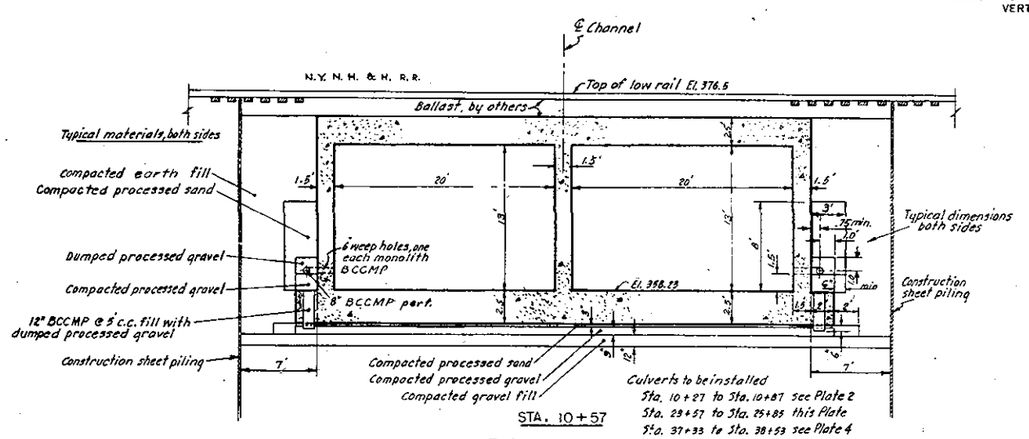
U. S. ARMY



PLAN
SCALE 1"=40'



PROFILE ON ℄ OF CHANNEL
SCALE HOR. 1"=40'
VERT. 1"=10'



TYPICAL SECTION
CONCRETE BOX CULVERT — TWO BARREL
SCALE 1"= 5'

NOTES

For typical section of "U" shaped concrete channel, see Plate No. 2-2.

GRAPHIC SCALES
1"= 10'
1"= 40'
1"= 5'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: CHIEF, SECTION

REVIEWED: PROJECT ENGINEER

APPROVED: CHIEF, DESIGN BRANCH

APPROVED DATE
CHIEF, ENGINEERING DIVISION

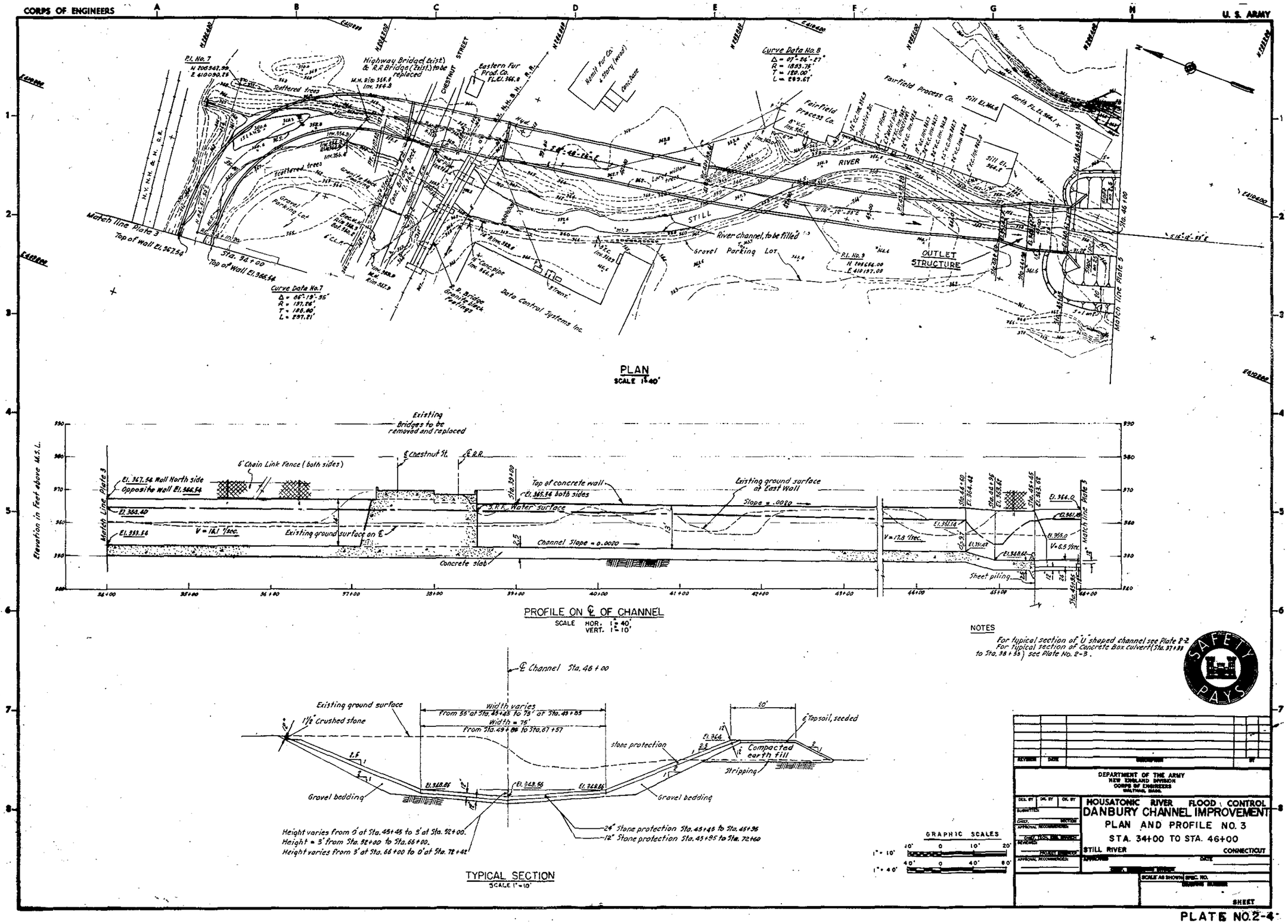
HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
PLAN AND PROFILE NO. 2
STA. 22+00 TO STA. 34+00
STILL RIVER CONNECTICUT

SCALE: AS SHOWN | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER

SHEET

PLATE NO. 2-3

CORPS OF ENGINEERS — U. S. ARMY



NOTES

For typical section of "U" shaped channel see Plate 8-2
For typical section of Concrete Box culvert (Sta. 37+93 to Sta. 38+55) see Plate No. 8-3.

SAFETY PAYS

GRAPHIC SCALES
1" = 10' — 20' 10' 0 10' 20'
1" = 40' — 80' 40' 0 40' 80'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

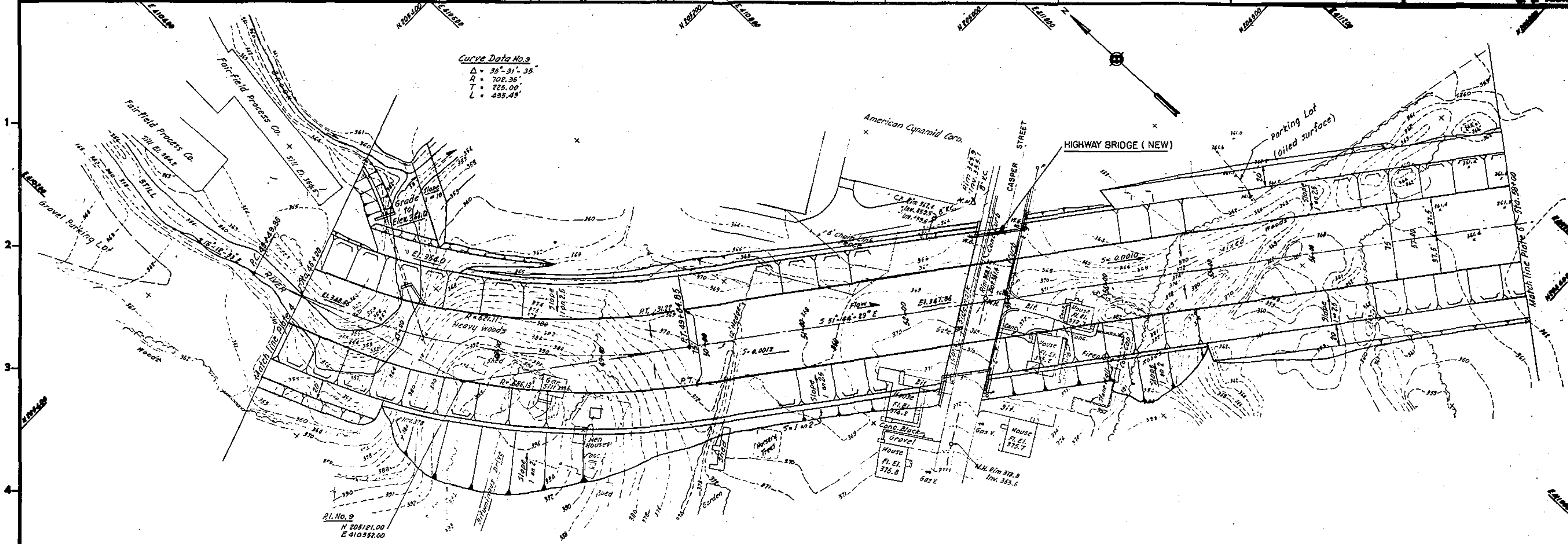
DES. BY | DR. BY | CK. BY
SUBMITTED
CHIEF, SECTION
APPROVAL RECOMMENDED
CHIEF, ENGR. DIV.
REVIEWED
CHIEF, PLANNING BRANCH
APPROVAL RECOMMENDED

HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
PLAN AND PROFILE NO. 3
STA. 34+00 TO STA. 46+00
STILL RIVER CONNECTICUT

APPROVED: DATE:
CHIEF, ENGINEERING DIVISION
SCALE AS SHOWN SPEC. NO.
DRAWING NUMBER
SHEET

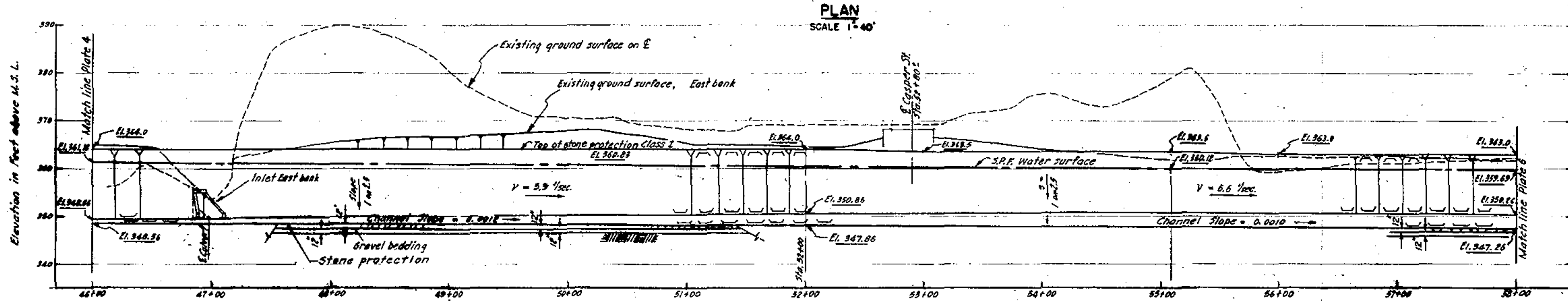
PLATE NO. 2-4

CORPS OF ENGINEERS | U. S. ARMY



PLAN

SCALE 1" = 40'

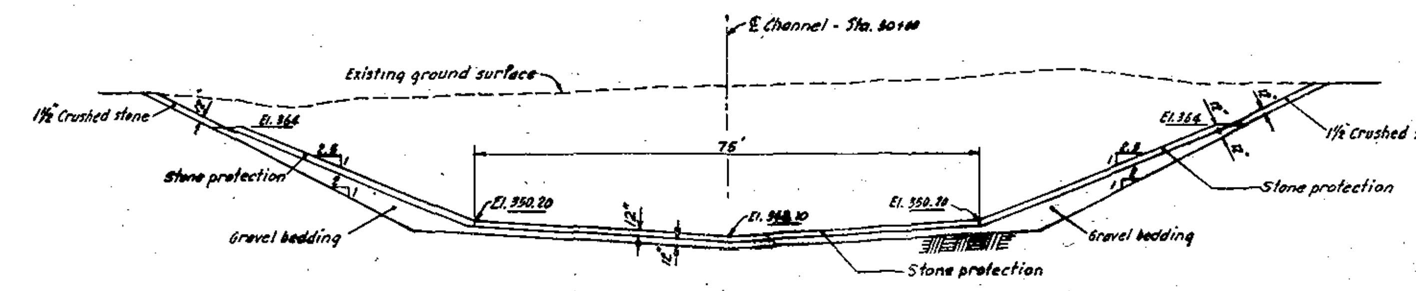


PROFILE ON ℄ OF CHANNEL

SCALE HOR. 1" = 40'
VERT. 1" = 10'

NOTES

For typical section from Sta. 46+00 to Sta. 49+45 see Plate No. 2-4.



TYPICAL SECTION

SCALE 1" = 10'

GRAPHIC SCALES
1" = 10' : 10' 0 10' 20'
1" = 40' : 40' 0 40' 80'

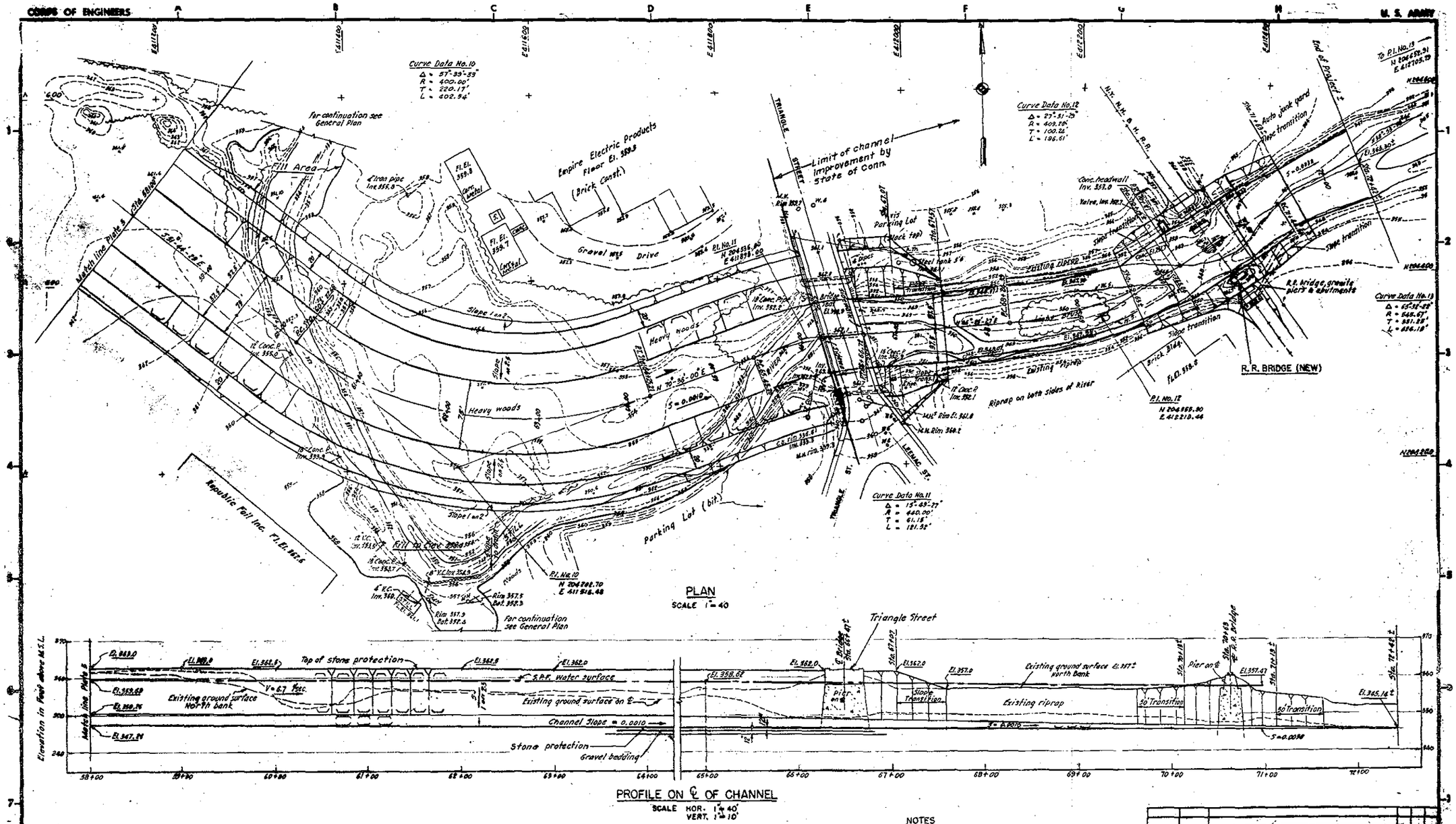
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
PLAN AND PROFILE NO. 4
STA. 46+00 TO STA. 58+00
STILL RIVER CONNECTICUT

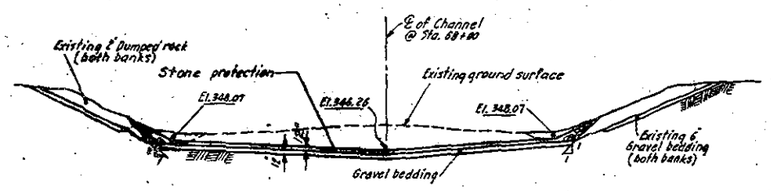
HOU

PLATE NO. 2-5

CORPS OF ENGINEERS — U. S. ARMY



PROFILE ON ℄ OF CHANNEL
SCALE HOR. 1" = 40'
VERT. 1" = 10'



TYPICAL SECTION
SCALE 1" = 10'

NOTES
For typical section from Sta. 58+00 to Sta. 67+07, and from Sta. 69+63 to 71+63 see Plate No 2-A.

GRAPHIC SCALES
1" = 10'
1" = 40'

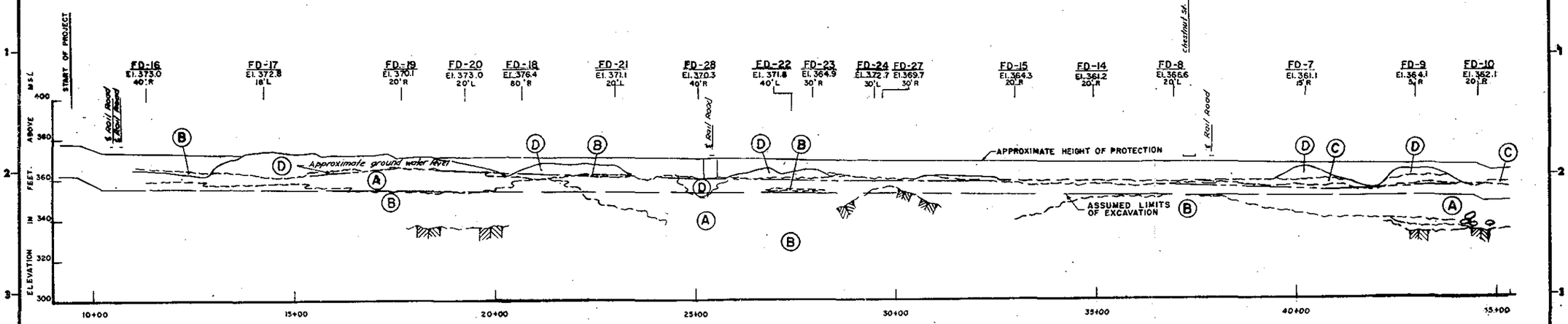
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
PLAN AND PROFILE NO. 5
STA. 58+00 TO STA. 72+60
STILL RIVER CONNECTICUT

HOU-

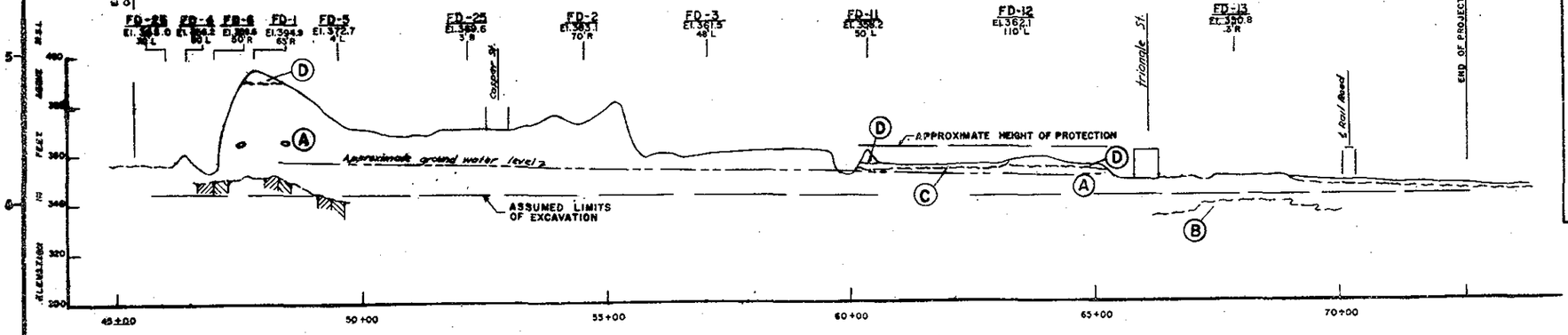
PLATE NO. 2-6

CORPS OF ENGINEERS — U. S. ARMY



GEOLOGIC PROFILE A-A
(CONCRETE 'U' SECTION)

SCALE VERT 1"=20'
HOR 1"=100'



GEOLOGIC PROFILE A-A
(DIKES AND CHANNEL IMPROVEMENT)

SCALE VERT 1"=20'
HOR 1"=100'

LEGEND	
DESIGNATION	DESCRIPTION
A	SILTY SANDS AND GRAVELS
B	SILTS, CLAYS AND HIGHLY SILTY FINE SANDS
C	ORGANIC DEPOSITS
D	FILL
	ASSUMED BEDROCK SURFACE MARBLE, WHITE, SURFACE WEATHERED TO DECOMPOSED
	BOULDERS

NOTES
For location of geologic sections
See Plate No. 2-1
For record of Foundation Explorations
See Plate Nos. 2-8 & 2-9

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED: Chief, Geology Section
APPROVAL RECOMMENDED: Chief, E & M Branch
REVIEWED: Project Engineer
APPROVAL RECOMMENDED:

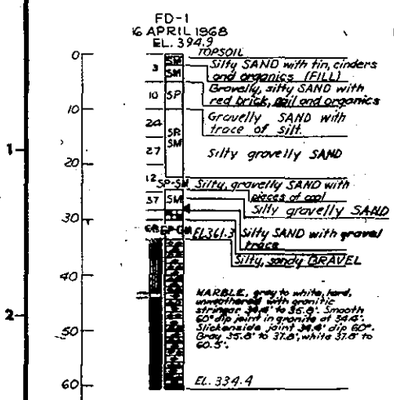
HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
GEOLOLIC PROFILE A-A
STILL RIVER CONNECTICUT

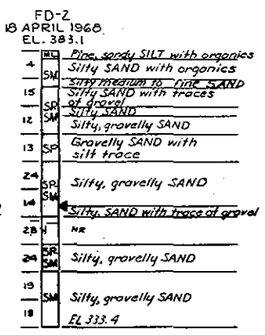
APPROVED Chief, Engineering Division DATE

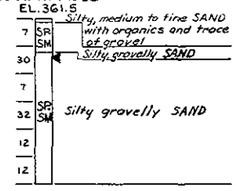
SCALE | SPEC. NO. ENG. 19-016-
DRAWING NUMBER
SHEET

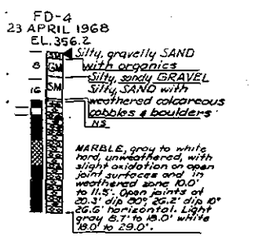
PLATE NO. 2-7

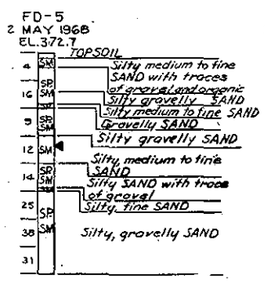
CORPS OF ENGINEERS — U. S. ARMY

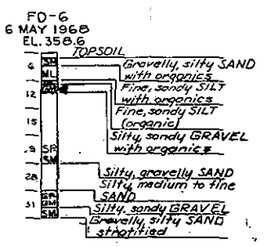


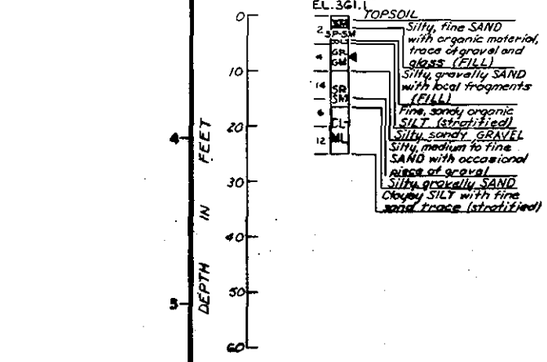


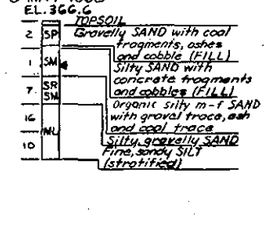


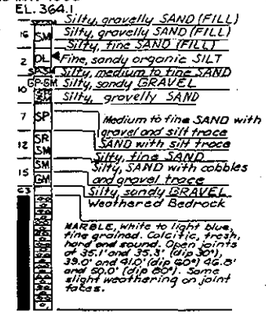


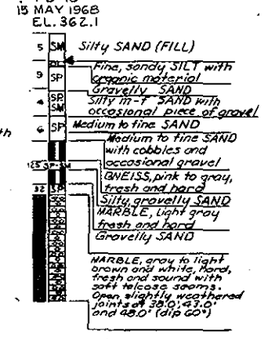


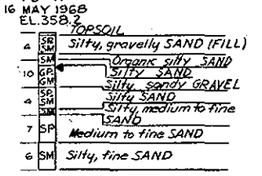


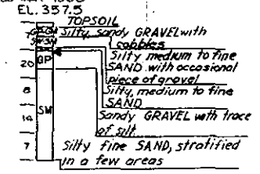


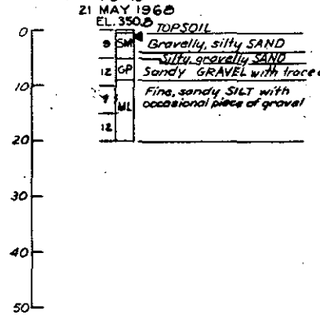


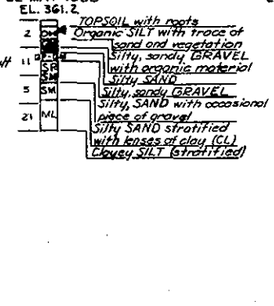


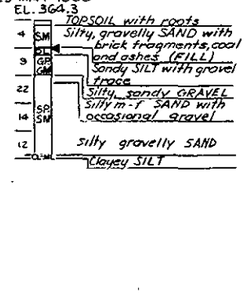


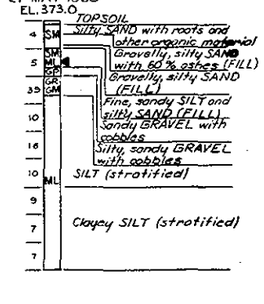


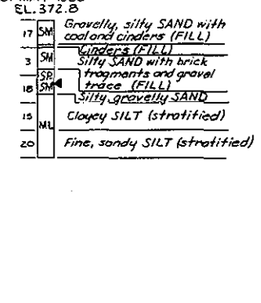


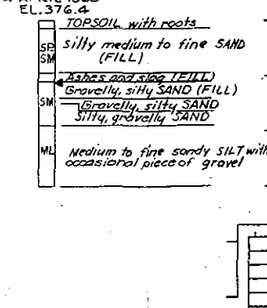












DEPTH IN FEET

LEGEND FOR GRAPHIC LOGS

FD — Foundation Test Boring.
3 MAY 1968 — Date Exploration Completed.
EL. 372.0 — Elevation of Ground Surface Time of Exploration.

- Maximum artesian head
- Subsurface water level in boring at time of exploration.
- Range of subsurface water during period of observation.
- Artesian flow encountered.
- SP — Group letter symbol according to Unified Soil Classification System.
- NR — No recovery or unsatisfactory soils samples recovered.
- NS — Not sampled. Hole advanced by Core drilling, blasting and/or wash boring due to operational difficulty
- Bottom of observation well
- CD — Sampling in overburden by Core-drill method.
- 35 — Blows per foot of penetration considered most representative for each sample drive using a 300 pound hammer with a free fall of about 18" on a standard, 5 foot, solid sample spoon with a beveled, sharpened drive shoe.
- Cobble or boulder (Core-drilled)
- Cobbles or boulders, continuous or nested (Core-drilled and/or blasted and chopped)
- EL. 360.1 — Elevation of bedrock surface.
- Rock symbol
- Rock Core Recovery 0-25%
- Rock Core Recovery 25-50%
- Rock Core Recovery 50-75%
- Rock Core Recovery 75-90%
- Rock Core Recovery 90-100%
- EL. 610.1 — Elevation, bottom of exploration.

NOTES:
Elevations refer to mean sea level datum
For location of foundation explorations. See plate NO.2-1

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:
CHIEF, GEOLOGY SECTION
APPROVAL RECOMMENDED:
CHIEF, T & M BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:

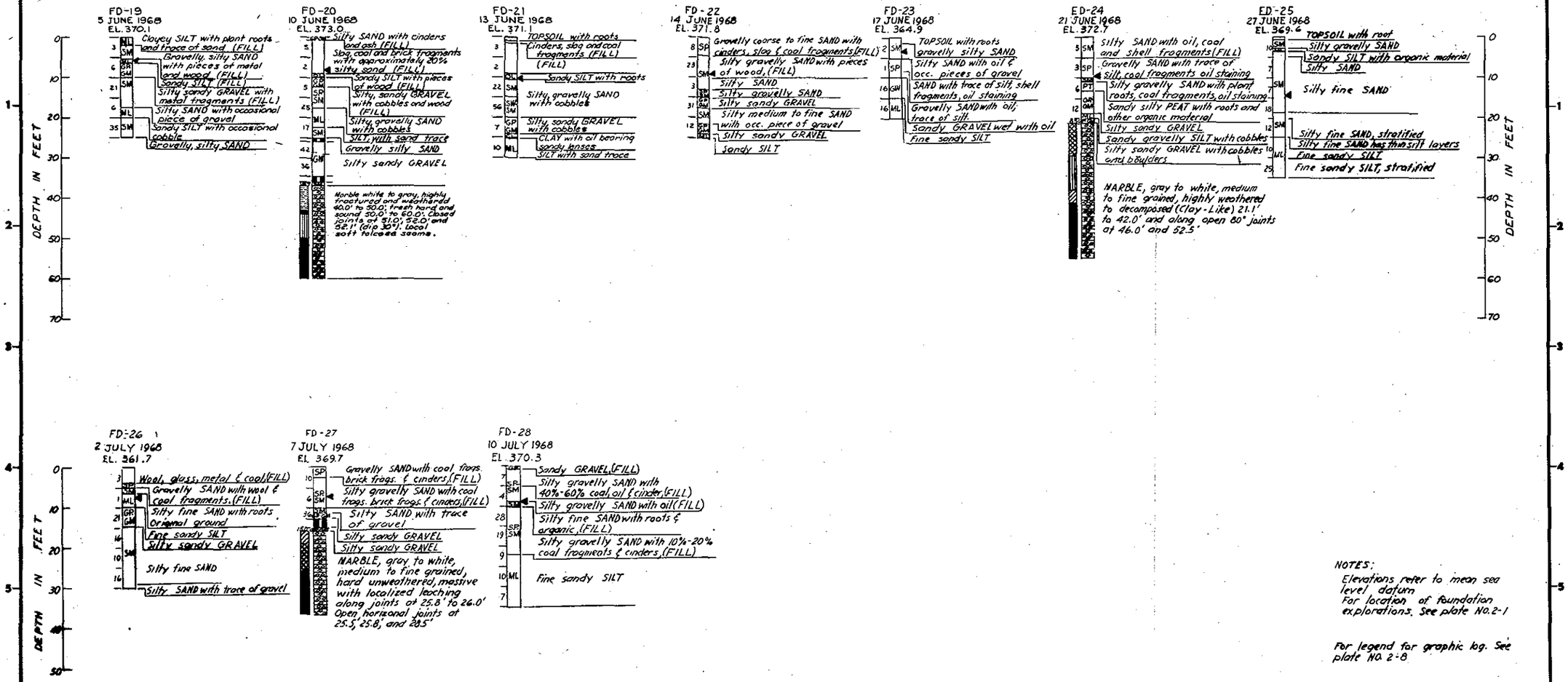
HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
RECORD OF FOUNDATION EXPLORATIONS
NO I.
STILL RIVER CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 2-8

CORPS OF ENGINEERS — U. S. ARMY



NOTES:
Elevations refer to mean sea level datum
For location of foundation explorations. See plate NO. 2-1

For legend for graphic log. See plate NO. 2-8

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

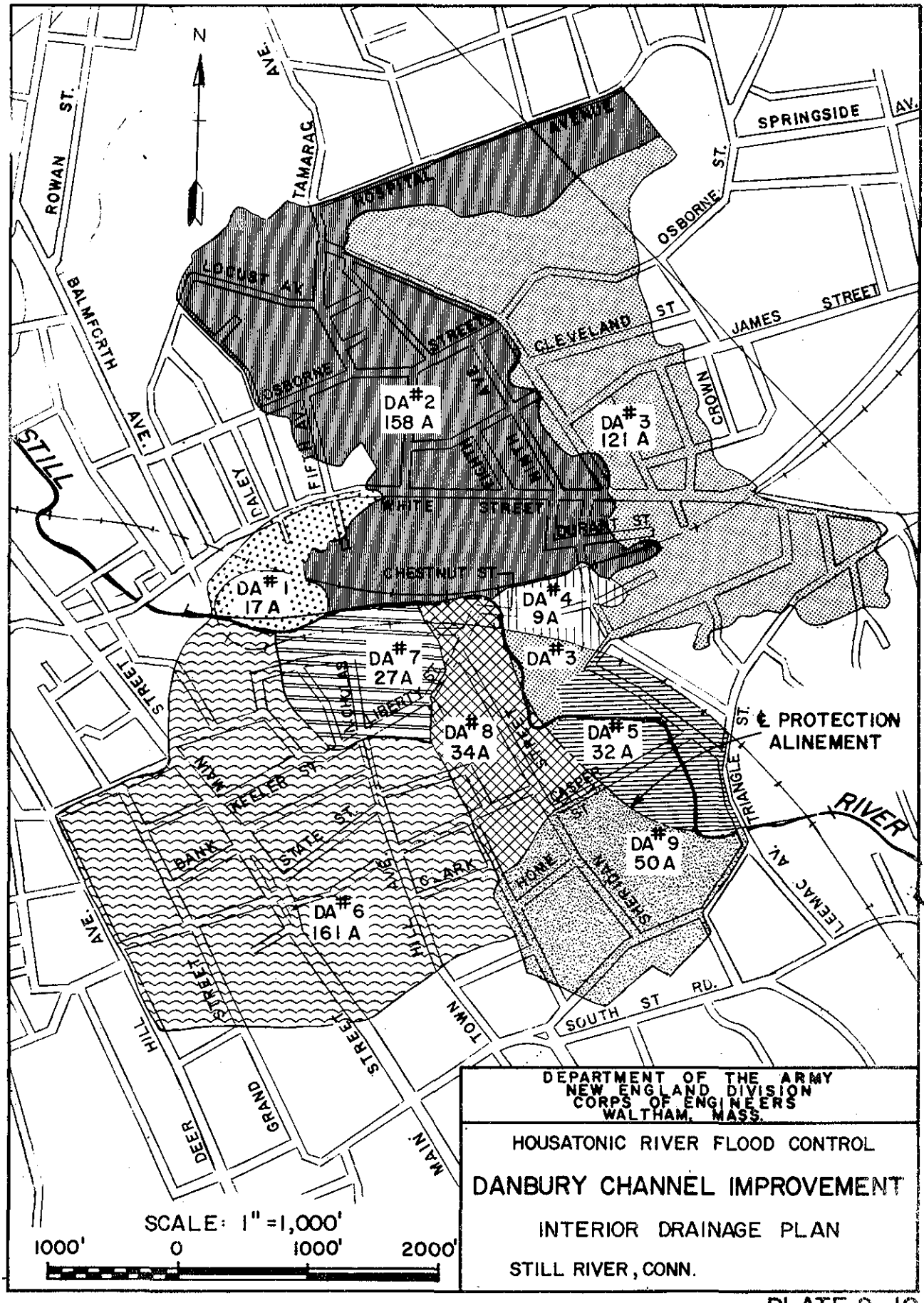
SUBMITTED
CHIEF, GEOLOGY SECTION
APPROVAL RECOMMENDED
CHIEF, E & D BRANCH
REVIEWED
PROJECT ENGINEER
APPROVAL RECOMMENDED

HOUSATONIC RIVER FLOOD CONTROL
DANBURY CHANNEL IMPROVEMENT
RECORD OF FOUNDATION EXPLORATIONS
NO. 2.
STILL RIVER CONNECTICUT

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE
SPEC. NO. ENG. 19-000-
CONTRACT NUMBER
SHEET

PLATE NO. 2-9



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL

DANBURY CHANNEL IMPROVEMENT

INTERIOR DRAINAGE PLAN

STILL RIVER, CONN.

PLATE 2-10

CORPS OF ENGINEERS

U. S. ARMY

LEGEND		
NEW	EXISTING	DESCRIPTION
—NSD—	—SD—	STORM DRAINAGE
—NSS—	—SS—	SANITARY SEWER
	—W—	WATER
	—G—	GAS
■ DMH	□ DMH	DRAIN MANHOLE
○	○	SEWER MANHOLE
■ D.I.	□ D.I.	DRAIN INLET
	→	DIRECTION OF FLOW
		CHANNEL RELOCATION

N

MOSS AVENUE

FIFTH AVENUE

WHITE STREET

MAIN STREET

DELAY STREET

RAILROAD

COMSTOCK STREET

PAHQUIOQUE AVENUE

LIBERTY ST.

LIBERTY STREET

SHERIDAN STREET

MATCH LINE PLATE

HOUSATONIC RIVER FLOOD CONTROL

DANBURY LOCAL PROTECTION

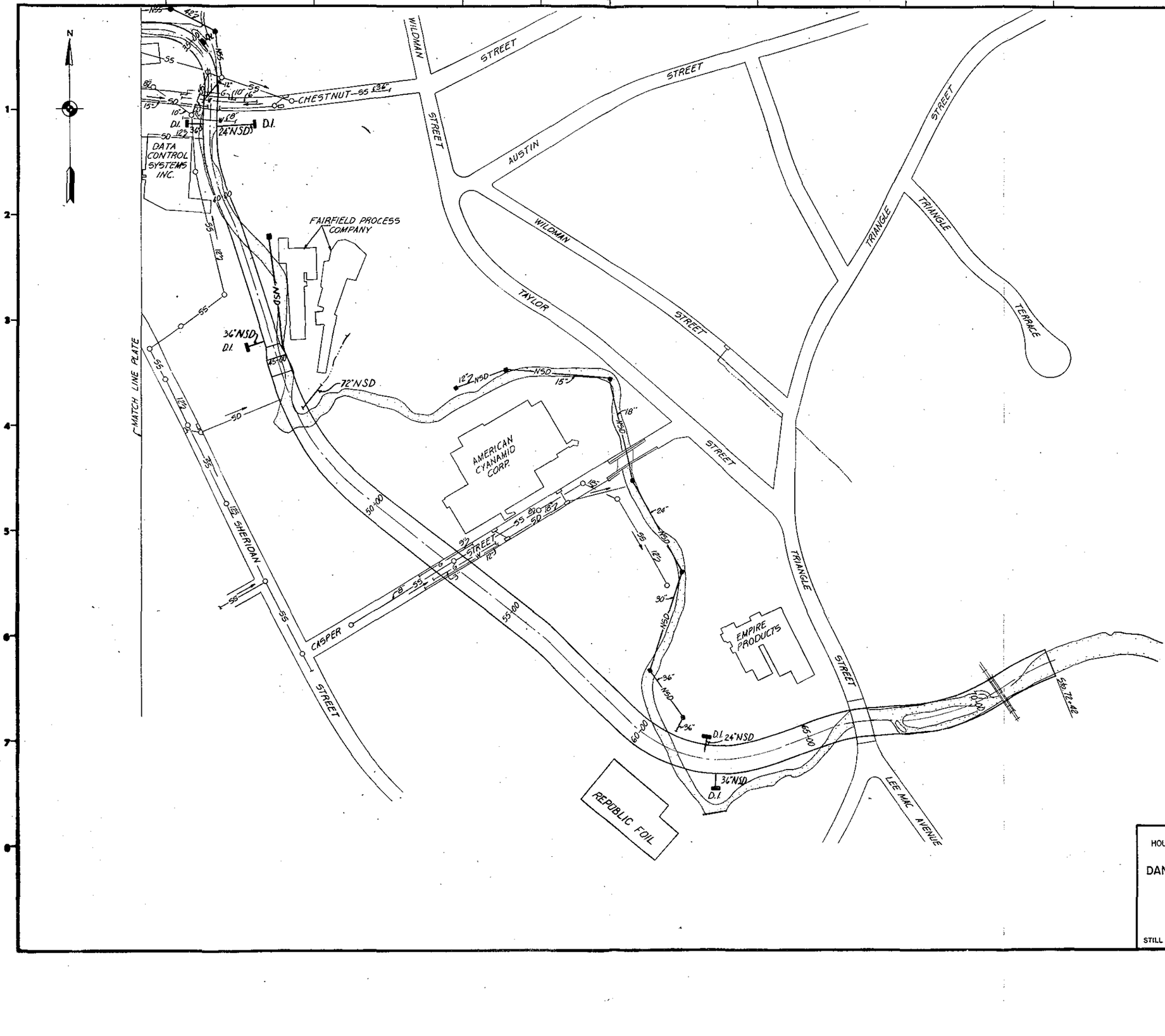
UTILITY LAYOUT NO. 1

STILL RIVER DANBURY, CONNECTICUT

PLATE NO. 2-11

CORPS OF ENGINEERS

U. S. ARMY



HOUSATONIC RIVER FLOOD CONTROL

DANBURY LOCAL PROTECTION

UTILITY LAYOUT NO. 2

STILL RIVER — DANBURY, CONNECTICUT

PLATE NO. 2-12

APPROPRIATION CLASSIFICATION: TITLE: Construction, General — LOCAL PROTECTION (FLOOD CONTROL)

PROJECT: DANBURY, CONNECTICUT

ACTIVITY LEGEND

DETAILED PROJECT SCHEDULE (PB-2A)

(TO BE REPORTED IN THOUSANDS OF DOLLARS)

LINE NO.	COST ACCOUNT NO.	ITEM	CONT. TYPE & NO.	QUANTITY SIZE, OR CAPACITY; DATE OF AWARD (As Applicable)	PROJECT COST ESTIMATE	TOTAL AS OF JUNE 30, 19 68	FISCAL YEAR 19 69 TOTAL	FISCAL YEAR 19 69 QUARTERS 1st	2nd	3rd	4th	CONSTRUCTION FISCAL YEAR NO. 1 TOTAL	CONSTRUCTION FISCAL YEAR NO. 1 QUARTERS 1st	2nd	3rd	4th	FUTURE FISCAL YEARS 19 71 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	19 72 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	19 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	BALANCE TO COMPLETE
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)				(18)				(19)				(20)
1	02.	RELOCATIONS																										
2	.2	RAILROADS	C.C.	3/70	380.0							50.0				50.0	250.0				80.0							
3																												
4	09.	CHANNELS & CANALS	C.C.	3/70	4,258.0							250.0				250.0	2,200.0				1,808.0							
5																												
6	30.	ENGINEERING & DESIGN			350.0	92.5	133.5	50.5	26.0	17.0	40.0	70.0		30.0	35.0	5.0	30.0				24.0							
7																												
8	31.	SUPERVISION & ADMINISTRATION			282.0	12.9	18.1	6.0	4.0	3.0	5.1	30.0		5.0	4.0	21.0	120.0				101.0							
9																												
10		TOTAL APPLIED COST (Fed Funds Only)			5,270.0	105.4	151.6	56.5	30.0	20.0	45.1	400.0		35.0	39.0	326.0	2,600.0				2,013.0							
11		Undistributed Cost (None)																										
12		TOTAL PROJECT COST (Fed Funds Only)			5,270.0	105.4	151.6	56.5	30.0	20.0	45.1	400.0		35.0	39.0	326.0	2,600.0				2,013.0							
13		Pending Adjustments (None)																										
14		TOTAL COSTS (Fed Funds Only)			5,270.0	105.4	151.6	56.5	30.0	20.0	45.1	400.0		35.0	39.0	326.0	2,600.0				2,013.0							
15		Undelivered Orders				+5.1	-5.1																					
16		TOTAL OBLIGATIONS (Fed Funds Only)				110.5	146.5					400.0					2,600.0				2,013.0							
17																												
18																												
19		METHOD OF FINANCING																										
20		ALLOCATIONS				111.0	146.0																					
21		UNOBLIGATED CARRYOVER FROM PRIOR YEAR					0.5																					
22		TOTAL FUNDS AVAILABLE FOR OBLIGATION					146.5																					
23		APPROPRIATION REQUIRED										400.0					2,600.0				2,013.0							
24																												
25																												
26																												
27																												
28																												
29																												
30																												

EFFECTIVE DATE | DIVISION: NEW ENGLAND | DISTRICT | BASIN: NEW ENGLAND | PROJECT: DANBURY, CONNECTICUT | PAGE 1 OF 1 PAGES

ENG FORM 1 JAN 65 2201a REPLACES EDITION OF 1 JUN 64, WHICH MAY BE USED. (ER 11-2-101) (TRANSLUCENT)

PLATE NO. 2-13

APPENDIX A

LETTERS OF COMMENT

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
Region I
John Fitzgerald Kennedy Federal Building
Boston, Massachusetts 02203

PUBLIC HEALTH SERVICE

November 26, 1968

Mr. John Wm. Leslie
Department of the Army
NED, Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Mr. Leslie:

Reference is made to your letter requesting our comments on the health aspects of the proposed Local Protection Project on the Still River in the City of Danbury, Connecticut. A review of the enclosed plan and discussions with State authorities reveals that there would be no detrimental effects on water supply or recreation, since this area is not used for either. Positive health benefits will be realized through the prevention of flood damage in the area.

This Office has no objections to the proposed improvement.

Sincerely yours,

Harry F. Smith Jr.

Harry F. Smith, Jr.
Regional Water Supply Consultant
Water Supply & Sea Resources Program
Public Health Service, ECA

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
U. S. POST OFFICE AND COURTHOUSE
BOSTON, MASSACHUSETTS 02109

January 13, 1969

Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This is our conservation and development report on the Still River Local Protection Project in the City of Danbury, Fairfield County, Connecticut. Your study is being conducted under authority of Section 205 of the Flood Control Act of 1962. This report was prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 inc.), in cooperation with the Connecticut Board of Fisheries and Game and has its concurrence as indicated by letter dated December 24, 1968.

We understand that the plans include channel realignment, improvement, excavation, and backfilling in that portion of the river starting 50 feet upstream of the completed Still River Channel, Urban Renewal Project. Work will extend 6,350 feet downstream to a point 600 feet downstream from the Triangle Street Bridge, at the end of the Connecticut State Still River Channel Improvement Project. This project ties two existing improved channels together and completes channel improvements in the Still River through the City of Danbury. It will not be practical to design the present channel to maintain the original streambed elevation. Alignment with the existing channels renders this modification impractical.

We have ascertained that construction and operation of the project will not significantly affect the fish and wildlife resources of the area nor will it offer feasible opportunities for the improvement of these resources.

Please advise us of any changes made in the project plans so that we can re-evaluate the effects of the project on fish and wildlife and prepare a revised report if necessary.

We appreciate the opportunity to report on the proposed plans.

Sincerely yours,

Richard E Griffith

Regional Director

STATE OF CONNECTICUT
BOARD OF FISHERIES AND GAME
STATE OFFICE BUILDING HARTFORD, CONNECTICUT 06115

October 3, 1968

John Wm. Leslie
Chief, Engineering Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Thank you for the opportunity to review the plans for the Still River channel realignment and improvement in the City of Danbury, Connecticut.

Neither the preliminary plans nor your letter describe the bottom of the channel or the reinforced culvert at the railroad. Although the Still River does not now support a fishery of any value, this river is scheduled for pollution abatement and may in the future support a valuable sport fishery.

We would suggest that the bottom of the channel and the culverts be constructed in such a manner that a sufficient depth of water is maintained at minimum flows as to allow free upstream or downstream movement of fish.

Sincerely yours,

Theodore B. Bampton
Director

TBB:CWW/ed

STATE OF CONNECTICUT
BOARD OF FISHERIES AND GAME
STATE OFFICE BUILDING HARTFORD, CONNECTICUT 06115

November 13, 1968

Mr. John Wm. Leslie
Chief, Engineering Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Thank you for your letter of October 11, 1968 concerning the Still River Channel Improvement Project in Danbury.

In view of the circumstances, we recognize that it is not feasible to carry out our suggestions as presented in my letter of October 3, 1968.

Sincerely yours,

Theodore B. Bampton
Director

TBB:CWW/ed

STATE OF CONNECTICUT

WATER RESOURCES COMMISSION

STATE OFFICE BUILDING ● HARTFORD, CONNECTICUT 06115

December 10, 1968

Mr. John Wm. Leslie
Chief, Engineering Division
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Danbury Channel Improvement
General Plan
Still River

Dear Sir:

This is in reply to your letter of September 27, 1968 presenting the preliminary plans and specifications for the "Danbury Flood Protection Project."

After analyzing the adequacy of the project design for the Corps' assumed design flood of 1.6 times the flood of record (6900 cubic feet per second), as set forth in the report dated September 13, 1963 entitled "Housatonic River Basin," we find the design adequate for the flood flow specifications used by this Commission for the area.

Upon reviewing the plans, the following was evident:

the retention of the railroad yards, and the use of a reinforced concrete channel in the yard area.

We assume that the added cost of the reinforced concrete channel is justified by local development plans.

Upon completion of the project the Water Resources Commission anticipates establishing encroachment lines along the existing project to insure maintenance of the realized project benefits.

Great benefits will accrue to the City of Danbury and State of Connecticut from operation of this project.

We feel that the conditions existing in the Danbury area justify speedy action to complete this project. We urge you to take all possible action to obtain early completion of this project.

Very truly yours,

Charles J. Pelletier
Division Engineer

CJP/tm

cc: Hon. Gino J. Arconti

2

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
REGION ONE

990 Wethersfield Avenue
Hartford, Connecticut 06114

October 7, 1968

IN REPLY REFER TO: 01-06.2

Mr. John Wm. Leslie
Chief, Engineering Division
Department of the Army
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Your September 25 letter brought to our attention the relocation of Still River in Danbury, Connecticut. We find that at this relocation Connecticut has long range plans for the Danbury-Bethel Connector to Interstate 84. The attached sketch shows three lines that have been studied for this connector with line C passing in the vicinity of your project. The plans for the construction are in the distant future and should not take precedent over the Still River Channel realignment that you proposed.

We are notifying the Highway Department about your project so that when action is taken on selecting the route of the expressway, this additional information will be in their files.

Sincerely yours,

E. J. DePina
Division Engineer

Attachment:

APPENDIX B

ATTORNEY'S REPORT

ATTORNEY'S REPORT

Re: Relocations - Danbury Local Protection Project, Danbury, Connecticut

1. Public Law 89-298, 89th Congress 1st Session, approved 27 October 1965 provided for a local flood protection project on the Still River in the City of Danbury, Fairfield County, State of Connecticut. This project is authorized substantially as recommended by the Chief of Engineers in House Document Numbered 324, 88th Congress 2nd Session at a then estimated cost of $5,100,000.00.

2. Within the proposed project area, there are four railroad bridges which will interfere with the construction, operation and maintenance of the project. There are no roads, water, gas, telephone, or electric lines or sewage facilities which will require relocation at Government expense. Therefore, alteration at Government expense is only required for the aforementioned railroad bridges.

3. The Penn Central Railroad's interest in the railroad bridges was acquired by deed by its predecessor Railroad Corporation as follows:

John F. Beard to Danbury & Norwalk Railroad - 1st Parcel

Samuel Holley et al to Housatonic Railroad

Charles H. Merritt to New York, New Haven & Hartford Railroad

Abjah P. Ely to New York, New Haven & Hartford Railroad

Frederick S. Wildman to Danbury & Norwalk Railroad

E. Mygott, Jr. et al to Danbury & Norwalk Railroad

John F. Beard to Danbury & Norwalk Railroad - 2nd Parcel

4. The Penn Central Railroad is the surviving successor corporate organization of the above-grantee Railroads. It is therefore, the opinion of the undersigned that the Penn Central Railroad has a compensable interest in the railroad bridges and is entitled to the reasonable cost of relocation, rearrangement or alteration.

Michael G. Finnerty

MICHAEL G. FINNERTY
Attorney, Real Estate Division

15 January 1969